

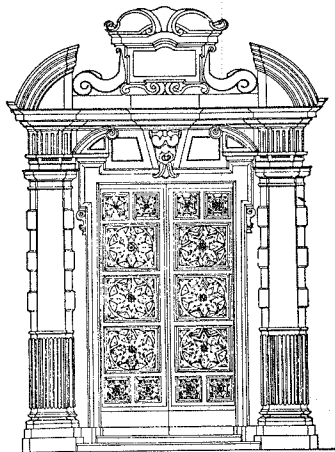
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The ant Genus *Proceratium* in  
the extant and fossil record  
(Hymenoptera: Formicidae)

Cesare Baroni Urbani and Maria L. de Andrade

COPIA OMAGGIO



Torino - 2003

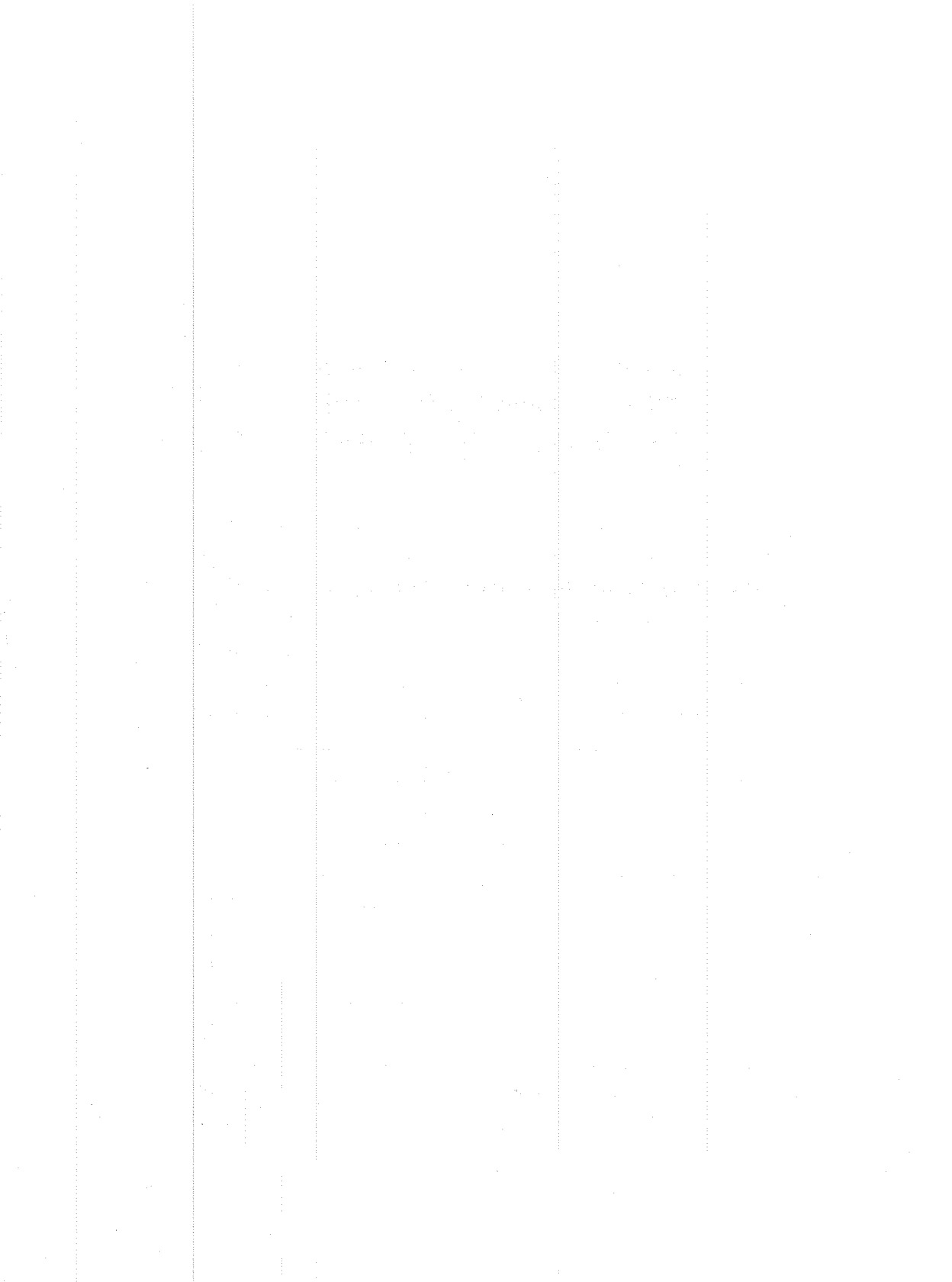
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## INTRODUCTION

The genus *Proceratium* comprises rare ants distributed irregularly in the tropical and temperate areas of the world. In the Old World the genus occurs from Spain to Japan, through SE Asia, sub Saharan Africa, Mauritius, the Malay Archipelago, New Guinea, SE Queensland, Fiji, and, in the New World, from south Canada to the south of Brazil and in some Caribbean islands. Together with two even rarer genera, the pantropical and subtropical *Discothyrea* and the extinct Baltic amber *Bradoponera* it constitutes the ponerine tribe Proceratiini.

All three genera share the abdominal segment IV curved to a major or minor extent. Although this character is not unique to the Proceratiini it gives them a characteristic appearance and makes them easy to separate from the majority of other ants. At least in *Proceratium*, the curved gaster should have a phragmotic function (Poldi, 1964). This reverse phragmotic explanation receives some support from the presence, in some species, of a probable gland with the opening directed backward on the posterior border of abdominal tergum IV reported for the first time in the present paper (Fig. 1 & 2). Presence of this gland seems to be universal within what we shall later call the *arnoldi* and the *silaceum* clades. Some species of these clades (i. e. *angulinode* and *striativenter*) at the end of the A IV tergum present also a characteristic integumental folding that we interpret as hosting the glandular opening (Fig. 3).

Brown (1958a) re-defined the tribe Ectatommini and merged in it the three Proceratiini genera, an opinion contrasted by Wheeler & Wheeler (1985) and others. On the other hand, in the same Ectatommini revision, Brown (l. c.) gives abundant evidence for the synonymy of *Sysphincta* with *Proceratium*, an opinion uncontested afterwards that we also share. A cladistic analysis by Lattke (1994) gives a list of potential apomorphies for both tribes, Ectatommini and Proceratiini. This action represents, in our opinion, the most reasonable approach to the problem.

The genus *Proceratium* to date comprises 30 valid names representing

29 extant and one fossil species (Bolton, 1995). Brown (1958a) recognises seven species groups within the genus and later (Brown, 1980) describes another new species, *diplopyx* from Madagascar, as the sole representative of its own group.

Lattke (1990) described the first fossil *Proceratium* from Dominican amber.

The species of *Proceratium* are known to nest essentially in soil, in rotten wood, under deep-set stones but even in tree branches (Brown, 1958a, 1974). Some species of *Proceratium* are recognised to be egg predators of arthropods, especially of spiders Brown (1958b, 1980).

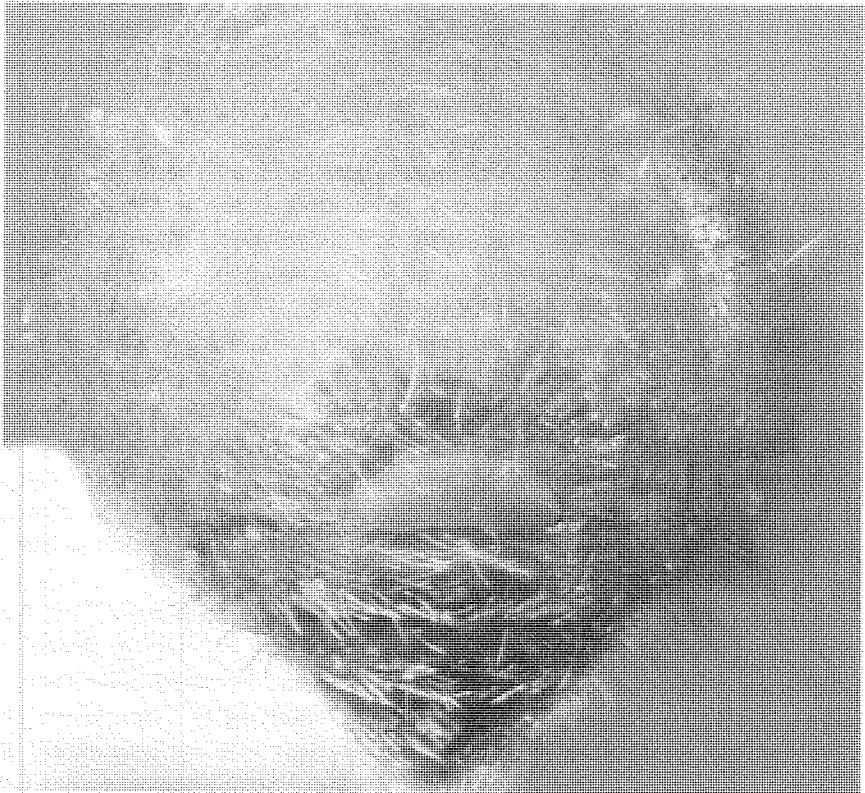


Fig. 1 – *Proceratium croceum* (Roger) first gastral tergite (fourth abdominal) of the worker in posterior view showing the presumed glandular area in transparency. The presence of this previously undescribed gland is considered as a potential confirmation of the phragmotic function of the curved gaster of the genus.



These ants are not only rare for being sparsely distributed but also the number of individuals per colony is reported to be small.

Menozzi (1925) describes an obviously incomplete nest of *P. melinum* composed of 57 workers, 28 gynes, 12 males but no brood. Kennedy & Talbot (1939) report a colony of *P. silaceum* from Pelee Island (Canada) containing 60 workers, 73 males, one dealate gyne, larvae and pupae. Wesson & Wesson (1940) describe a *P. pergandei* colony from Ohio containing a queen, 11 workers and 8 males.

Brown (1958a), probably summarising literature information, states that the number of specimens per colony can vary between 10-50 workers and

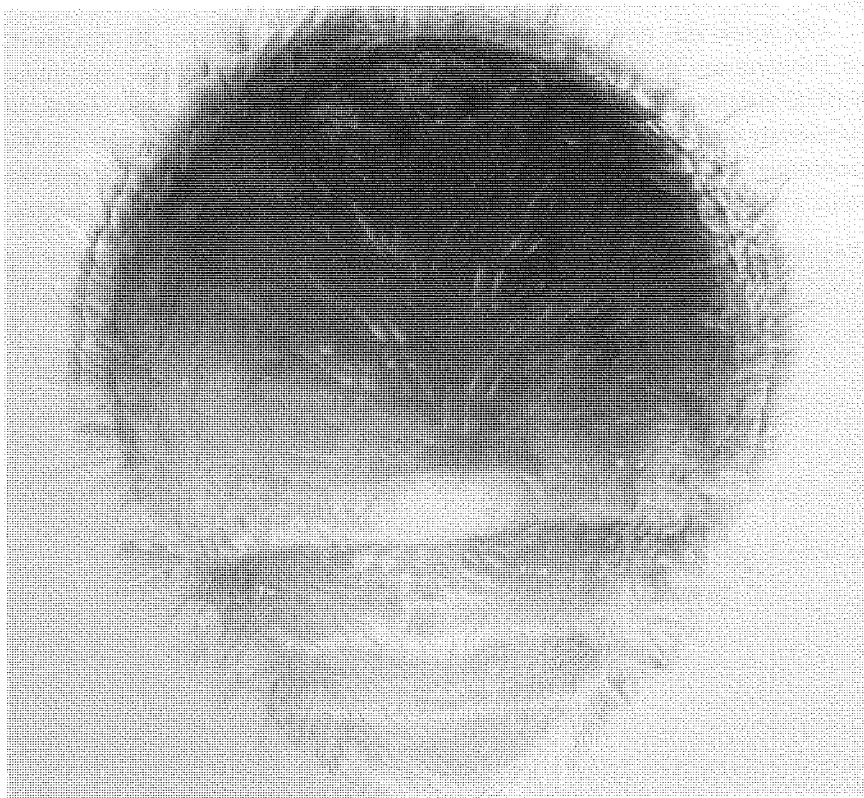


Fig. 2 – *Proceratium silaceum* Roger, first gastral tergite (fourth abdominal) of the worker in posterior view showing the presumed glandular area in transparency. The presence of this previously undescribed gland is considered as a potential confirmation of the phragmotic function of the curved gaster of the genus.

one dealate gyne and that sometimes more than one queen can be present in a nest. The older reports by Menozzi (1925) and by Kennedy & Talbot (1939) refer to nest populations with slightly more than 50 individuals for *P. melinum* and *silaceum* respectively.

Recent observations in Japan by Okamoto (1972) and Masuko et al. (1985) on *P. itoi*, by Masuko et al. (1985) on *P. watasei*, and by Onoyama & Yoshimura (2002) on *P. japonicum* give colony populations over 100 and even over 200 workers. We doubt that these figures may represent a trait unique to Japanese *Proceratium*. We explain them as the result of more intensive search and we suppose that equally careful searches should give similar results for other species worldwide.

Our work was motivated by the opportunity to study over 30 specimens of *Proceratium* in Dominican amber referable to another three, still undescribed species, a *Proceratium* male in Mexican amber and a good sample of previously unstudied Recent material including a number of new species. We performed also a species-level cladistic analysis in an attempt to guess the most probable relationships between the fossil and the extant known species.

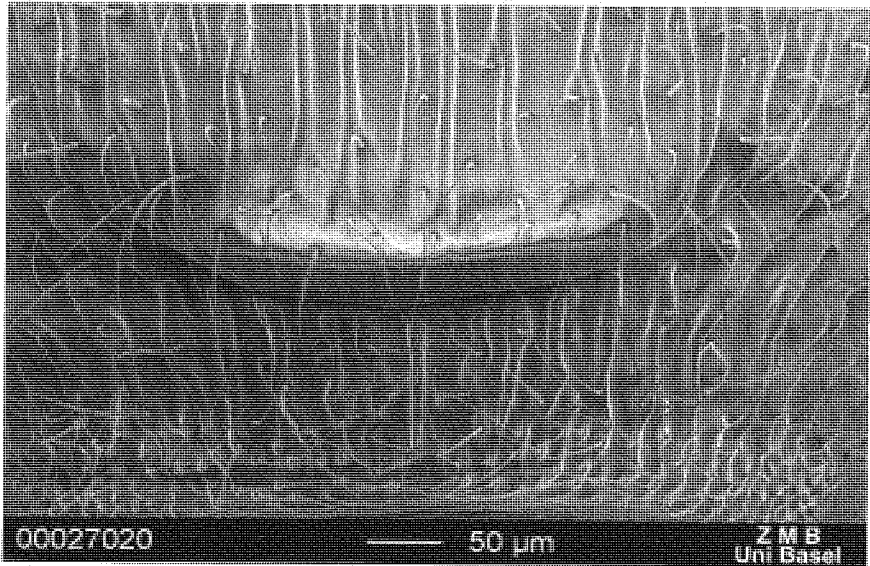


Fig. 3 – *Proceratium striativenter* de Andrade. Worker (holotype) from Mountain Santubong, Sarawak: first gastral tergite showing the integumental folding supposed to host the opening of the A IV tergal gland.

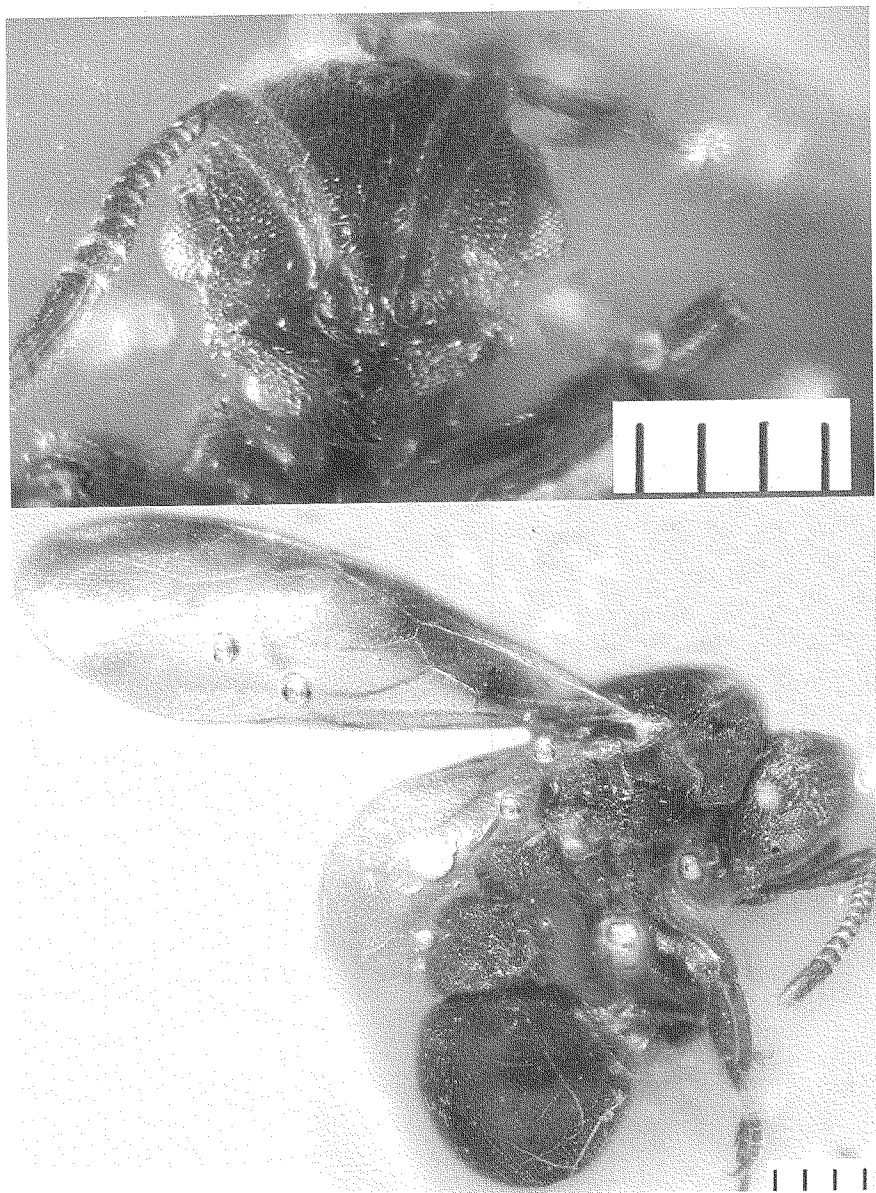


Fig. 4 – Dominican amber. Specimen Do-4253, head (top), and whole insect in profile (bottom). Distance between two scale bars 0.1 mm.

## MATERIAL AND METHODS

The following fossil specimens of *Proceratium* have been examined in 28 samples of amber from the Dominican Republic:

From the State Museum of Natural History, Stuttgart (Department of Phylogenetic Research):

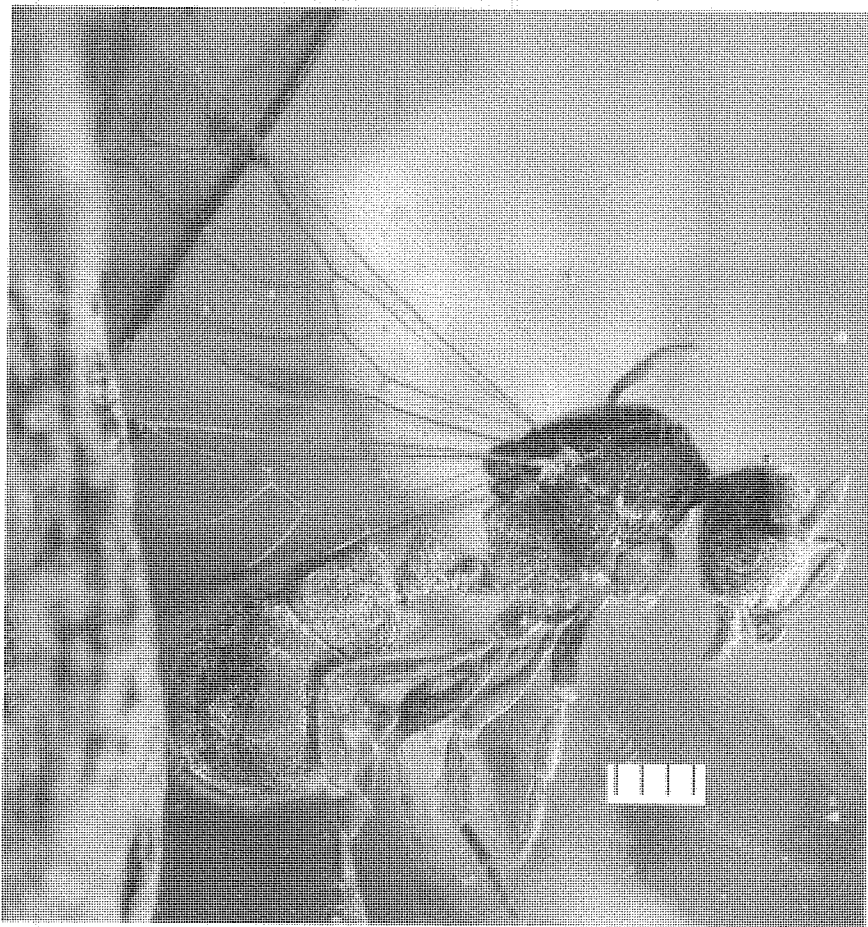


Fig. 5 – Dominican amber. Specimen Do-5188, side view. Distance between two scale bars 0.1 mm.

Do-4253 (Fig. 4). A small yellow sample containing only a winged *Proceratium* gyne. The ant was separately cut and re-embedded in polyester (Vosschemie Giessharz GTS). The preservation condition of the specimen is good.

Do-5188 (Fig. 5). A dark yellow sample, drop-shaped, 2.8 x 2.0 cm containing a winged gyne of *Proceratium*, three workers of Dolichoderinae, a cricket, a winged termite, a hemipteron, insect and vegetable remains. The *Proceratium* is in excellent shape.



Fig. 6 – Dominican amber. Profile of specimen H 10-156 B. Distance between two scale bars 0.1 mm.

From the collection of George O. Poinar Jr. deposited at the Oregon State University, Corvallis, Oregon.

H 10-119. Light yellow 3.5 x 2.2 cm sample including a *Proceratium* male, another ponerine male, two diptera, three microhymenoptera, and a worker of *Cephalotes bloosi*. Cutting the piece separated the ant males. The preservation of the *Proceratium* male is good.

H 10-156 A. A yellow sample, size 1.3 x 1.1 cm, containing a *Proceratium* male, a dipteran and air bubbles. The preservation condition of the ant is very good.

H 10-156 B. (Fig. 6). A yellow sample 2.3 x 1.3 cm, containing a *Proceratium* winged gyne, a small cricket, a microhymenopteron, and few impurities. The ant was separated by cutting and rendering it suitable for study.

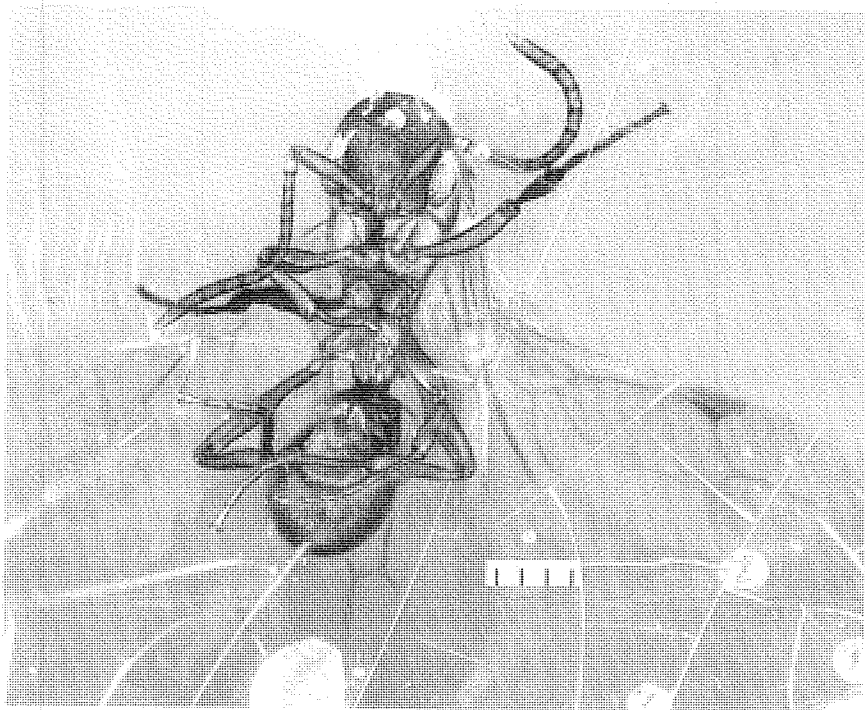


Fig. 7 – Dominican amber. Specimen H 10-156 C, in ventral view. Distance between two scale bars 0.1 mm.

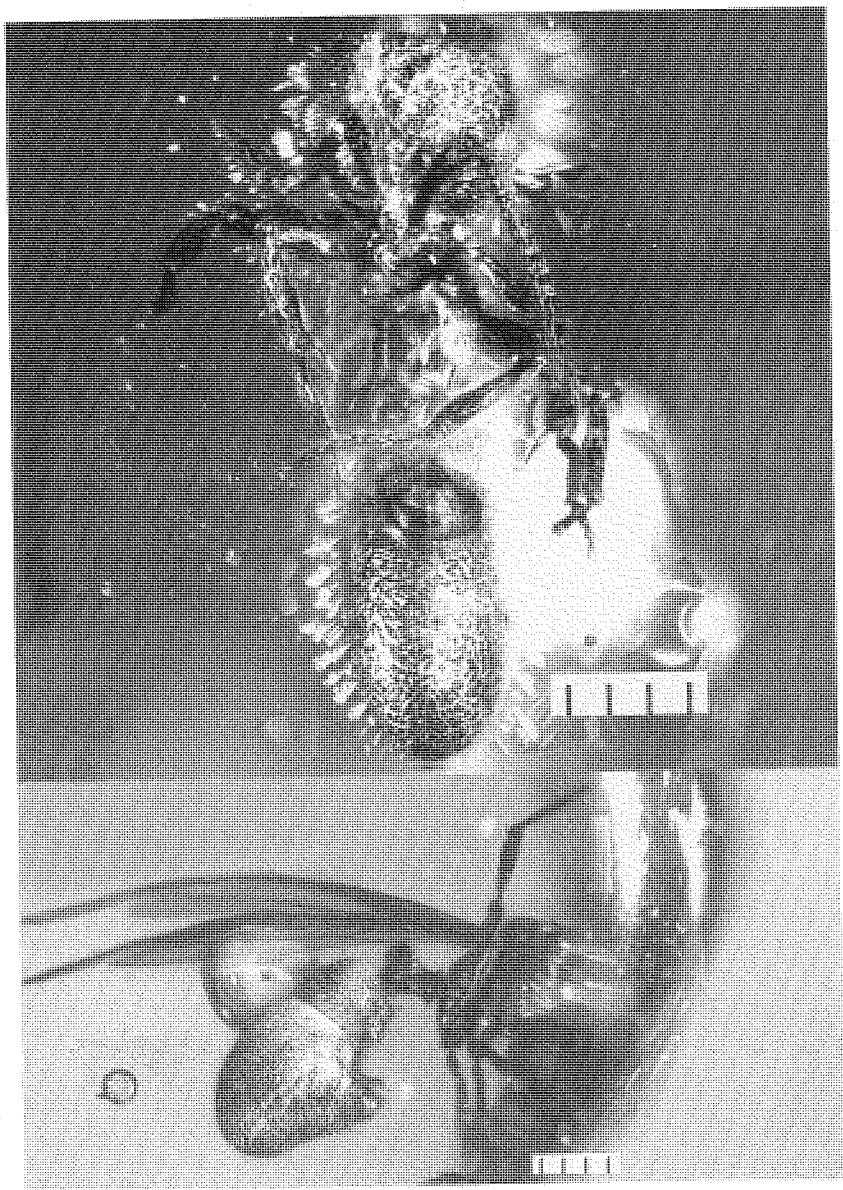


Fig. 8 – Dominican amber. Specimen H 10-156 G, ventral view (top), and profile (bottom). Distance between two scale bars 0.1 mm.

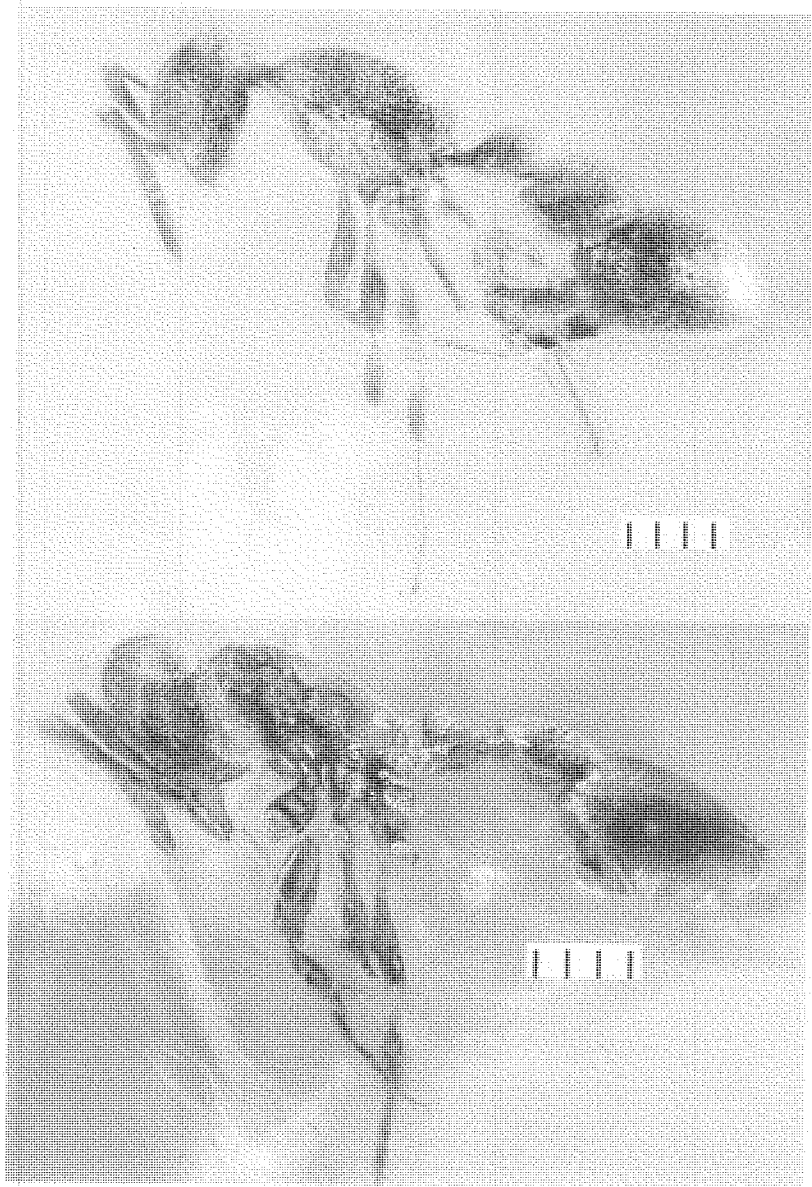


Fig. 9 – Dominican amber. Specimens H 10-156 K-1 (top) and H 10-156 K-2 (bottom), in profile. Distance between two scale bars 0.1 mm.



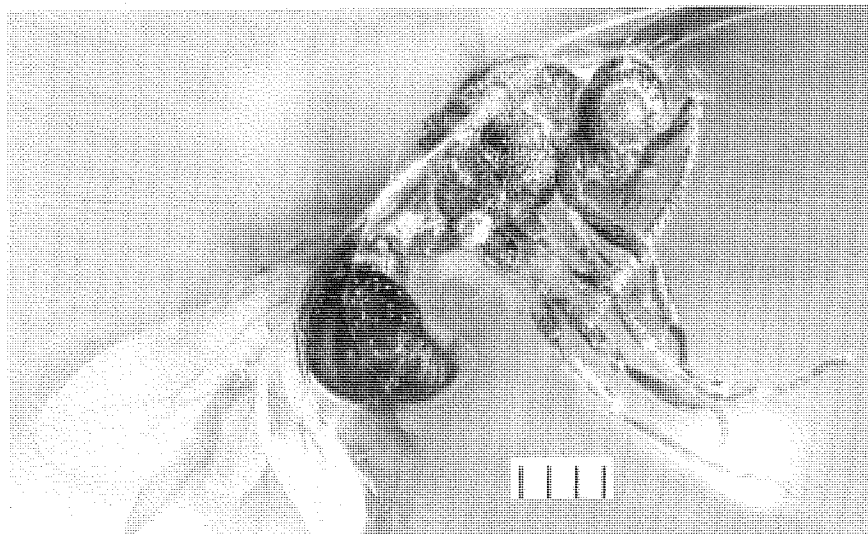


Fig. 10 – Dominican amber. Specimen H 10-178 B in profile. Distance between two scale bars 0.1 mm.

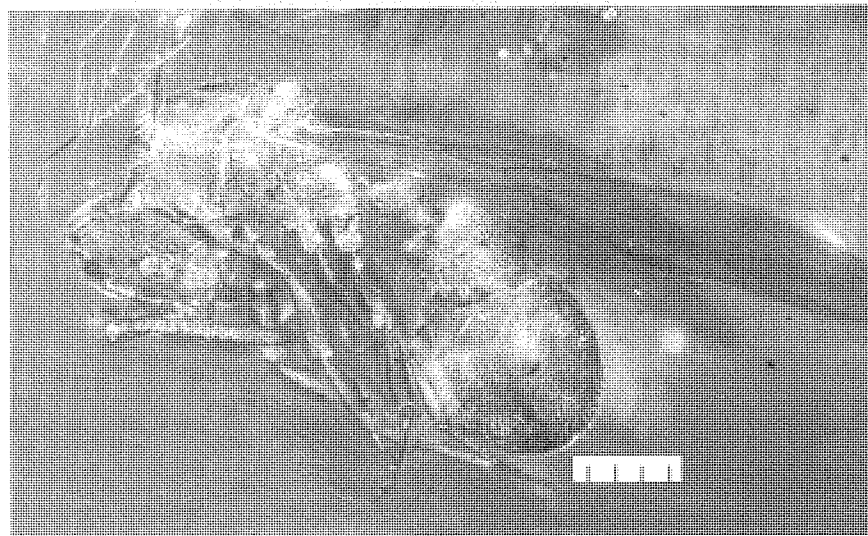


Fig. 11 – Dominican amber. Specimen H 10-221 in profile. Distance between two scale bars 0.1 mm.

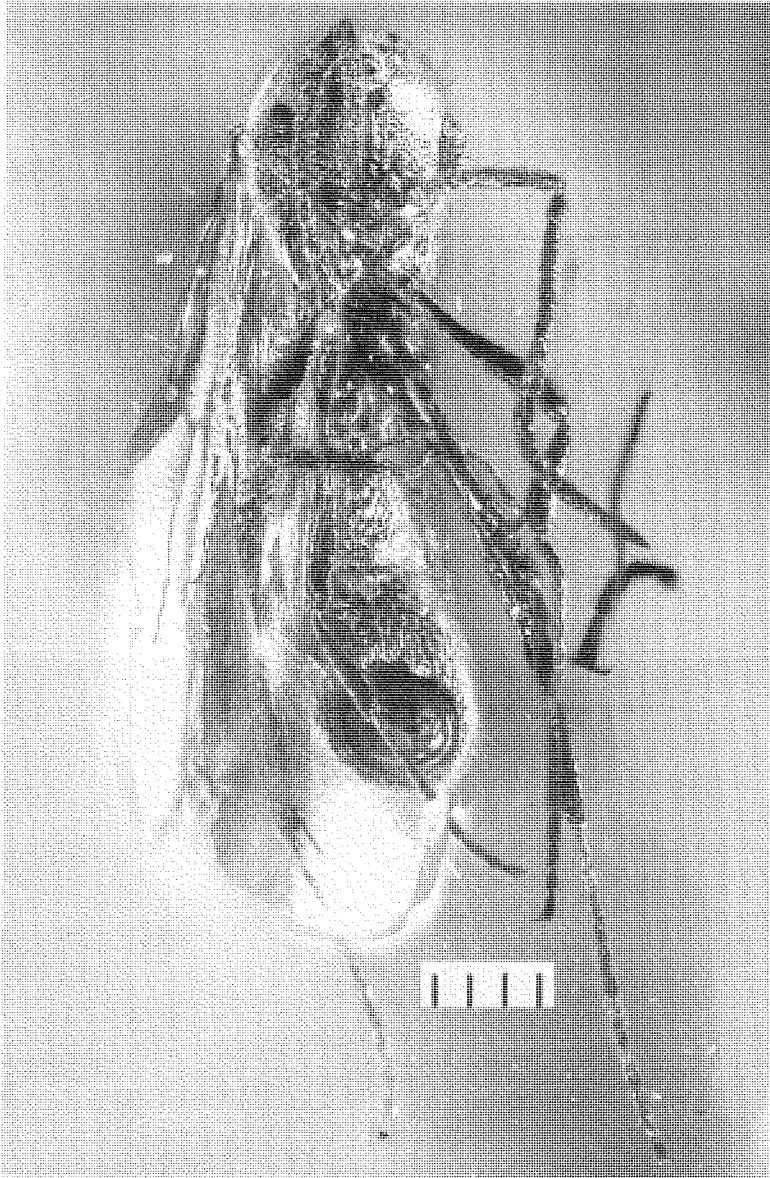


Fig. 12 – Dominican amber. Specimen H 10-222 in ventral view. Distance between two scale bars 0.1 mm.

H 10-156 C (Fig. 7.). A yellow sample 1.7 x 1.3 cm, containing a *Proceratium* male, 8 diptera, air bubbles and few impurities. The preservation condition of the ant is good.

H 10-156 F. A small sample containing a winged *Proceratium* gyne the vision of which is partly obscured by cracks and few impurities. The preservation condition of the ant is reasonable.

H 10-156 G (Fig. 8). A yellow sample 1.2 x 0.8 cm, containing a winged *Proceratium* gyne, a dolichoderine worker, air bubbles and few impurities. The preservation condition of the ants is good.

H 10-156 I. A yellow sample 1.1 x 0.8 cm, containing a *Proceratium* male and few impurities. The preservation condition of the ant is good.

H 10-156 K (Fig. 9). A yellow sample 2.3 x 1.7 cm, containing two *Proceratium* workers, two millipedes, faeces (probably of the millipedes) and few impurities. The ants were separately cut and were called respectively H 10-156 K-1 and H 10-156 K-2. Their preservation condition is good except for the following details: in H 10-156 K-1 the anterior petiolar peduncle is wrinkled and the tibiae and tarsomeres of mid left leg are missing and, the H 10-156 K-2 worker has lost most of the left legs (coxae and proximal part of femora remain).

H 10-156 L. A yellow sample 1.3 x 0.8 cm, containing a male *Proceratium* only. The preservation condition of the ant is good, although the tarsomeres are missing and some cracks on the amber surface confuse its view.

H 10-178 B (Fig. 10). A small sample containing only a male *Proceratium*. Its condition is good.

H 10-221 (Fig. 11). A yellow sample 2.9 x 1.7 cm containing a winged *Proceratium* gyne, a small dipteran and few impurities. The ant is in good shape.

H 10-222. (Figs. 12 & 13). A yellow sample 1.4 x 0.7 cm containing one *Proceratium* male, another ponerine male and one dipteran. The *Proceratium* male is in good shape.

From the Museum of Comparative Zoology, Harvard University, Massachusetts, USA.

All the MCZC *Proceratium* specimens have been arbitrarily numbered as MCZC-25, MCZC-26, etc. since the numbers 1 to 24 were already used in our previous *Cephalotes* revision (de Andrade & Baroni Urbani, 1999). Some of these specimens are of particular value because they bear a precise locality label with the name of the mine of provenance. The location of the

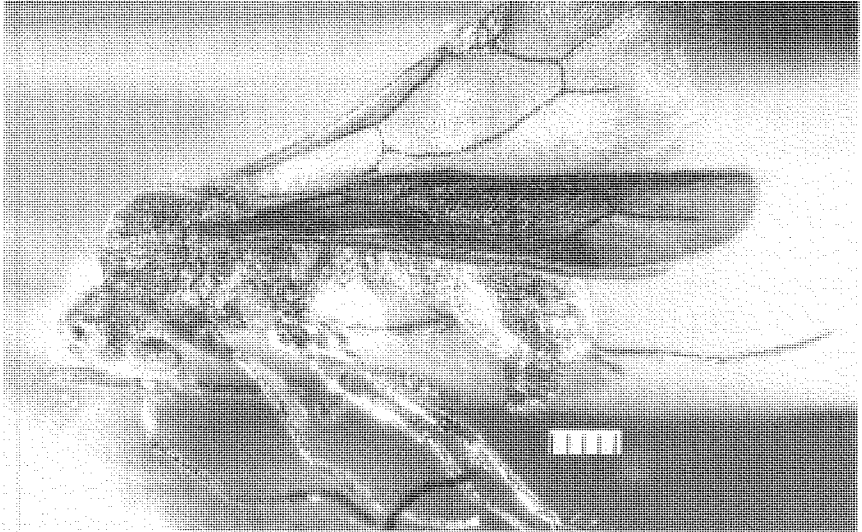


Fig. 13 – Dominican amber. Specimen H 10-222 in side view. Distance between two scale bars 0.1 mm.

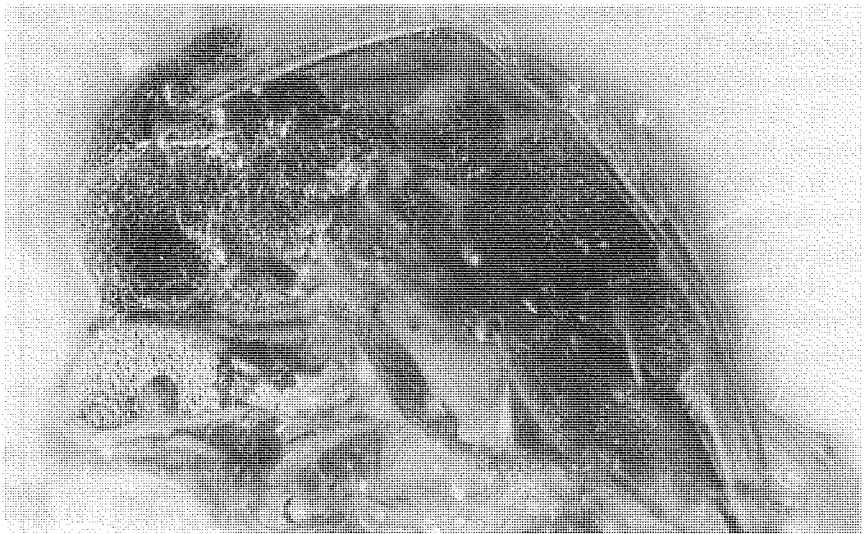


Fig. 14 – Dominican amber. Specimen MCZC-25, side view.

amber mines mentioned here can be found in the maps published by Baroni Urbani & Saunders (1982) and by Poinar (1992). They are as follows:

MCZC-25 (Fig. 14). A small yellow sample 1.8 x 1.7 cm from Yanigua, a small agglomeration 3 km W of the mine El Valle. It contains only a winged *Proceratium* gyne. The preservation condition of the specimen is good, although the tarsomeres of both hind legs are missing.

MCZC-26 (Fig. 15). A yellow sample 1.7 x 1.4 cm from La Toca, containing a *Proceratium* male, few impurities and partly obscured by cracks. The preservation condition of the specimen is good.

MCZC-27 (Fig. 16). A yellow sample 1.4 x 1.1 cm from the Santiago area, mounted as a pendant and containing a male of *Proceratium* and a few impurities. The preservation condition of the specimen is good.

MCZC-28 (Fig. 17). A yellow sample 1.7 x 1.4 cm from La Toca. It contains a *Proceratium* male and an unidentified insect. The preservation condition of the specimen is very good.

MCZC-29 (Fig. 18). A small yellow sample 1.0 x 0.7 cm from La Toca. It contains only a *Proceratium* male. The preservation condition of the specimen is very good.

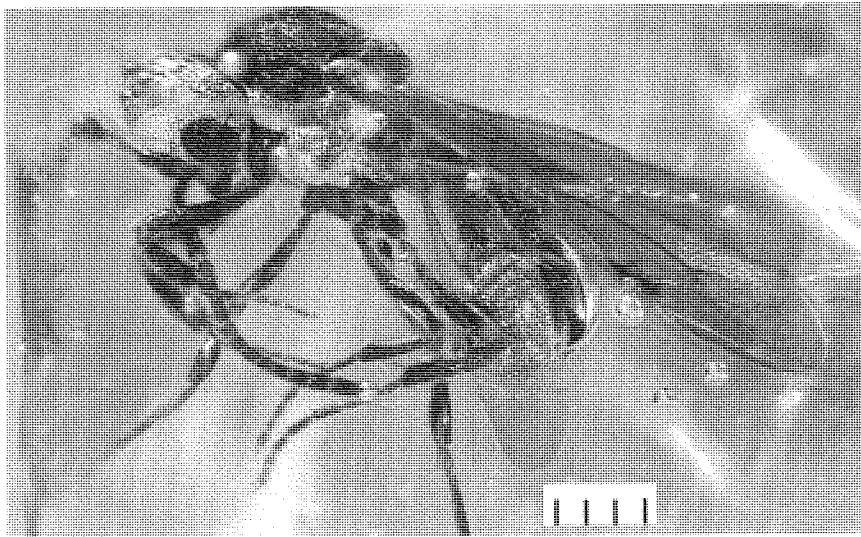


Fig. 15 – Dominican amber. Specimen MCZC-26, side view. Distance between two scale bars 0.1 mm.

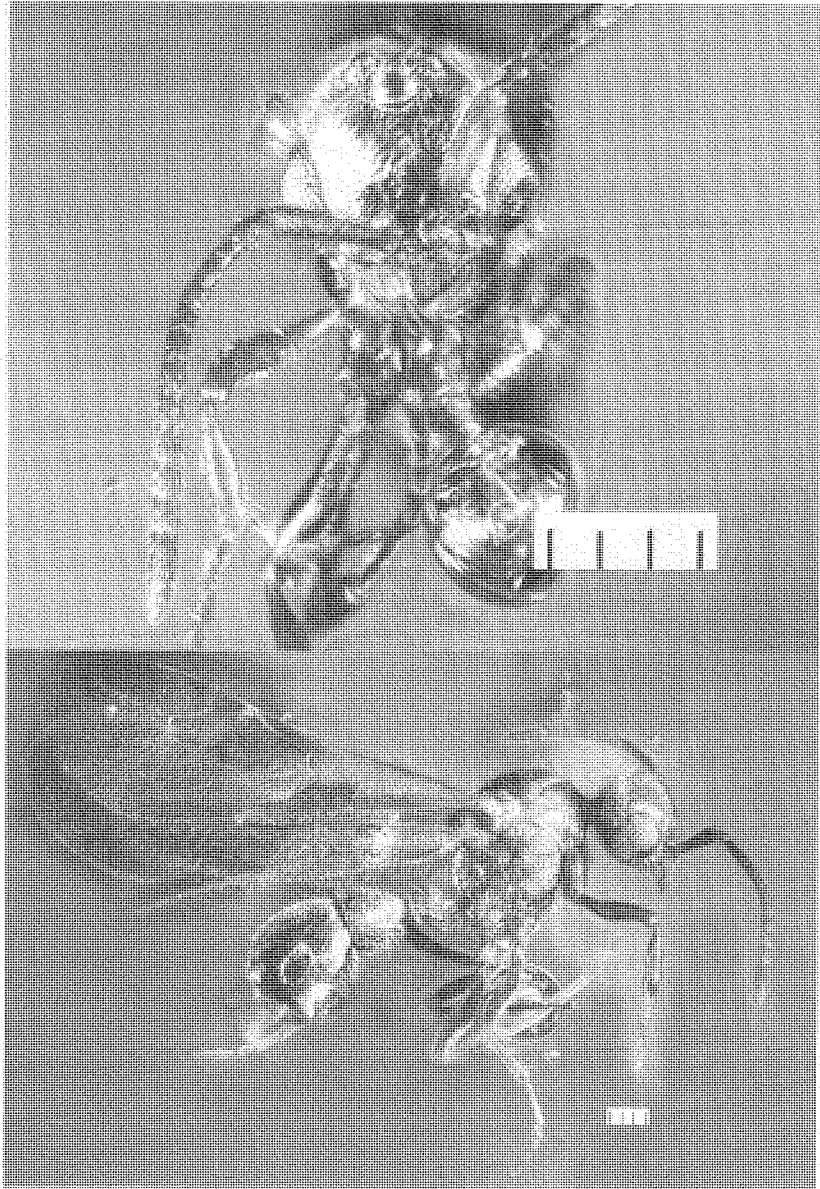


Fig. 16 – Dominican amber. Specimen MCZC-27, head in dorsal view (top), and in profile (bottom). Distance between two scale bars 0.1 mm.

MCZC-30. A yellow sample 1.6 x 1.5 cm from El Valle. It contains a *Proceratium* male and 22 diptera. The preservation condition of the ant is very good although fissures filled with brown material affect its body.

MCZC-31. A yellow sample 2.1 x 1.6 cm from El Valle. It contains a winged *Proceratium* gyne, a dipteran and part of an unidentified insect. The preservation condition of the ant is very good although a fissure filled with

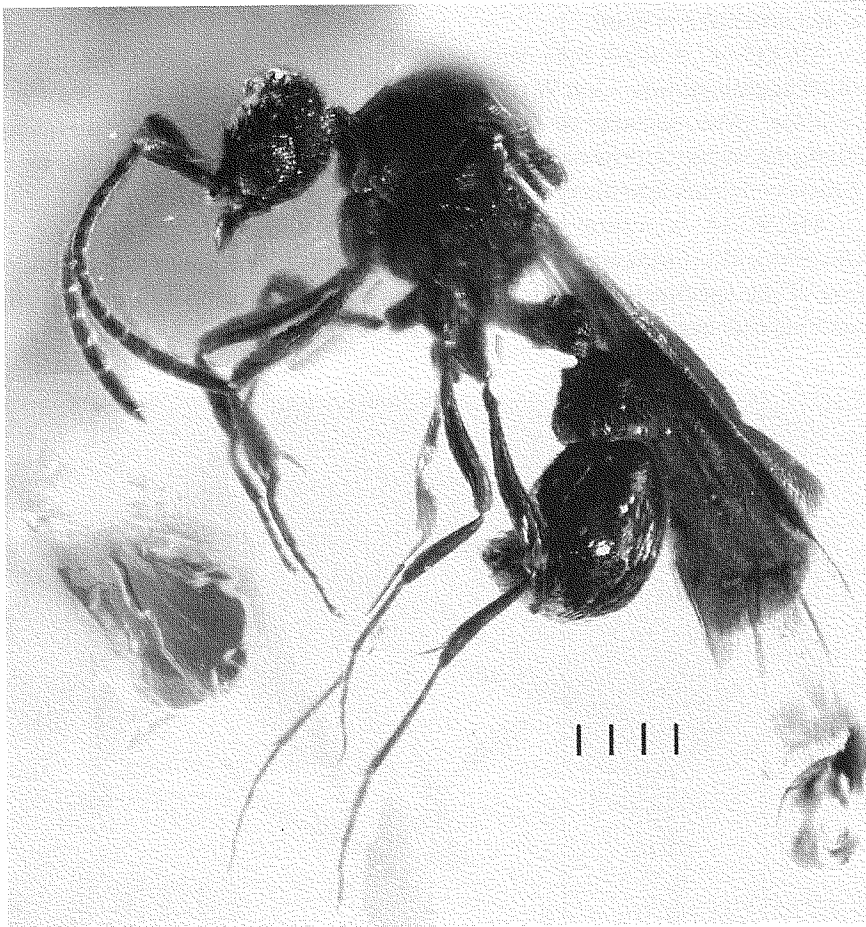


Fig. 17 – Dominican amber. Specimen MCZC-28, side view. Distance between two scale bars 0.1 mm.

brown material affects the body. The apex of the gaster and part of the mesosoma are covered by whitish spots.

MCZC-32. A small dark yellow sample 0.7 x 1.2 cm probably from El Valle. It contains a *Proceratium* male, many air bubbles and some cracks. The preservation condition of the specimen is good although its body is affected by many cracks filled with brown material.

MCZC-33. A small yellow sample 1.6 x 1.2 cm from El Valle. It contains a *Proceratium* male and many air bubbles. The preservation condition of the specimen is good.

MCZC-34. A small dark yellow sample 2.8 x 2.5 cm, from Yanigua, a small agglomeration 3 km W of the mine El Valle. It contains a winged *Proceratium* gyne, remains of an insect and few impurities. The preservation condition of the specimen is very good although the body is affected by a transversal crack and many other cracks filled by whitish material.

MCZC-35. A yellow sample 1.9 x 1.0 cm without further locality. It contains a *Proceratium* male and many air bubbles. The preservation condition of the specimen is good although the body is affected by cracks filled with whitish material.

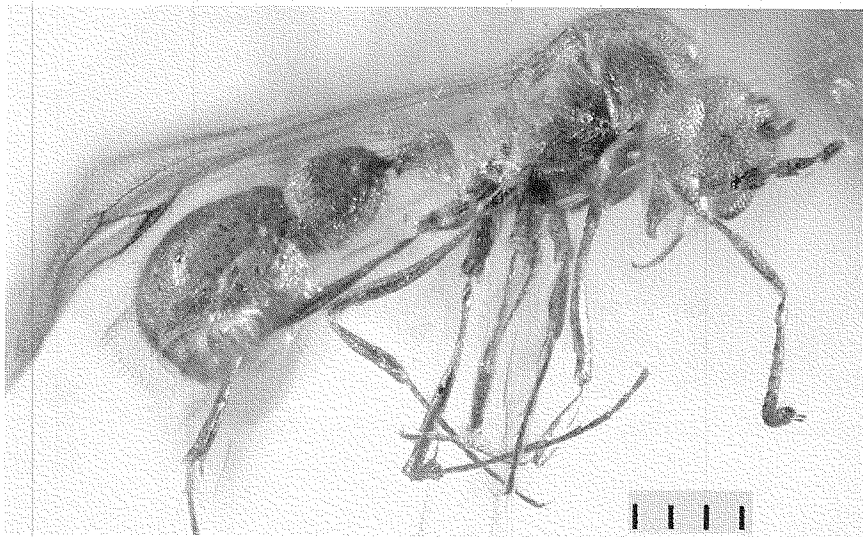


Fig. 18 – Dominican amber. Specimen MCZC-29, side view. Distance between two scale bars 0.1 mm.



From the Naturhistorisches Museum of Basle:

PE-25 (Figs. 19-23). A dark orange sample 5.7 x 2.4 cm containing 12 males and an alate gyne of *Proceratium*, one ponerine male, 4 diptera and impurities. The preservation condition of the specimens is good.

PE-46. A dark orange sample 2.7 x 1.6 cm, containing 1 *Proceratium* male, 29 males of Formicinae or Dolichoderinae (some of them incomplete), a mite, a microhymenopteron.

From the Museo del Instituto de Zoología Agrícola "Francisco Fernández Yépes":

A sample without number containing the holotype gyne of *Proceratium denticulatum* Latke (Fig. 24). The preservation condition of the ant is very good.

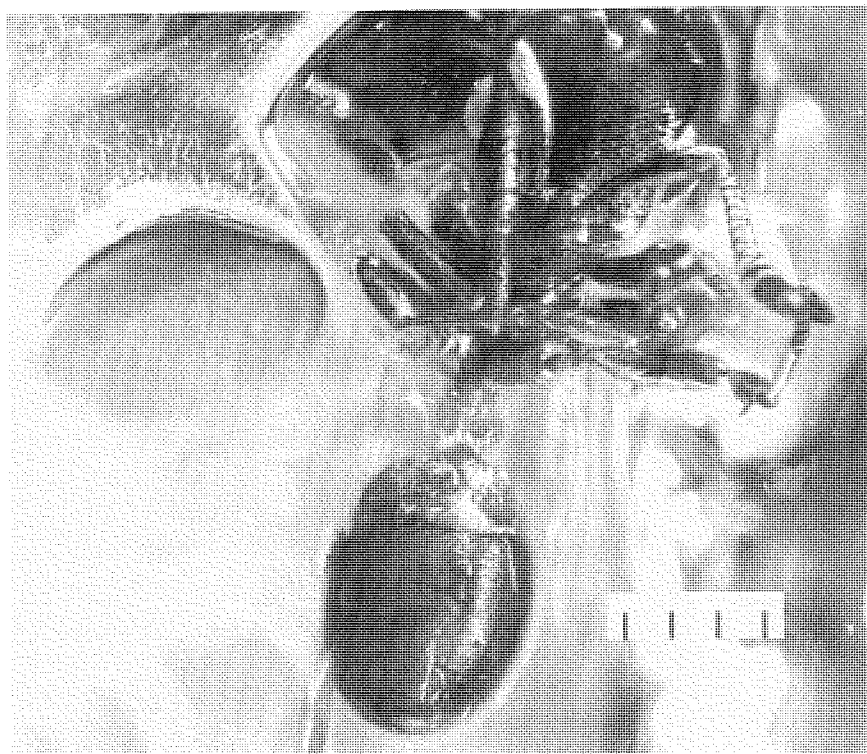


Fig. 19 – Dominican amber. Specimen PE-25-1, ventral view. Distance between two scale bars 0.1 mm.

An additional fossil *Proceratium* was examined in a sample of Mexican amber:

From the collection of George O. Poinar Jr. deposited at the Oregon State University, Corvallis, Oregon.

H 10-197 (Fig. 25). A yellow sample 2.3 x 1.2 cm containing a male *Proceratium*, the holotype male of *Discothyrea maya* de Andrade (H 10-197-1), four diptera, a coleopteron and few impurities. The *Proceratium* male was separately cut, polished and numbered as H 10-197-2. The preservation condition of this male is reasonable, though parts of its body are transparent and wrinkled.

Moreover, we were lucky in obtaining for study from Dr. J. Wunderlich of Straubenhardt five specimens of *Bradoponera* in Baltic amber representing the sole previously known species, *meieri*, and what appear to be another two, undescribed species.

The Recent *Proceratium* examined in this study are deposited in the following collections, given here with the relative coden as it will be used in the following text:

ABSC. Archbold Biological Station, Lake Placid, Florida. Courtesy of Dr. Mark A. Deyrup.

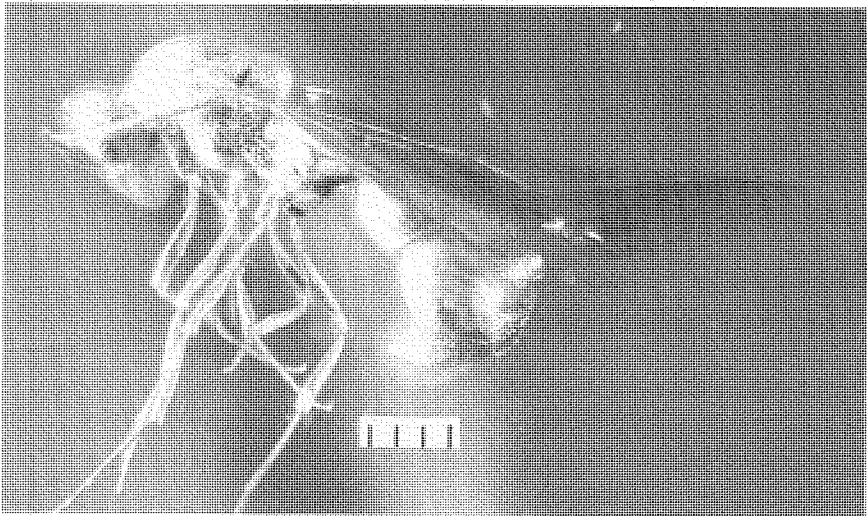


Fig. 20 – Dominican amber. Specimen PE-25-2, side view. Distance between two scale bars 0.1 mm.

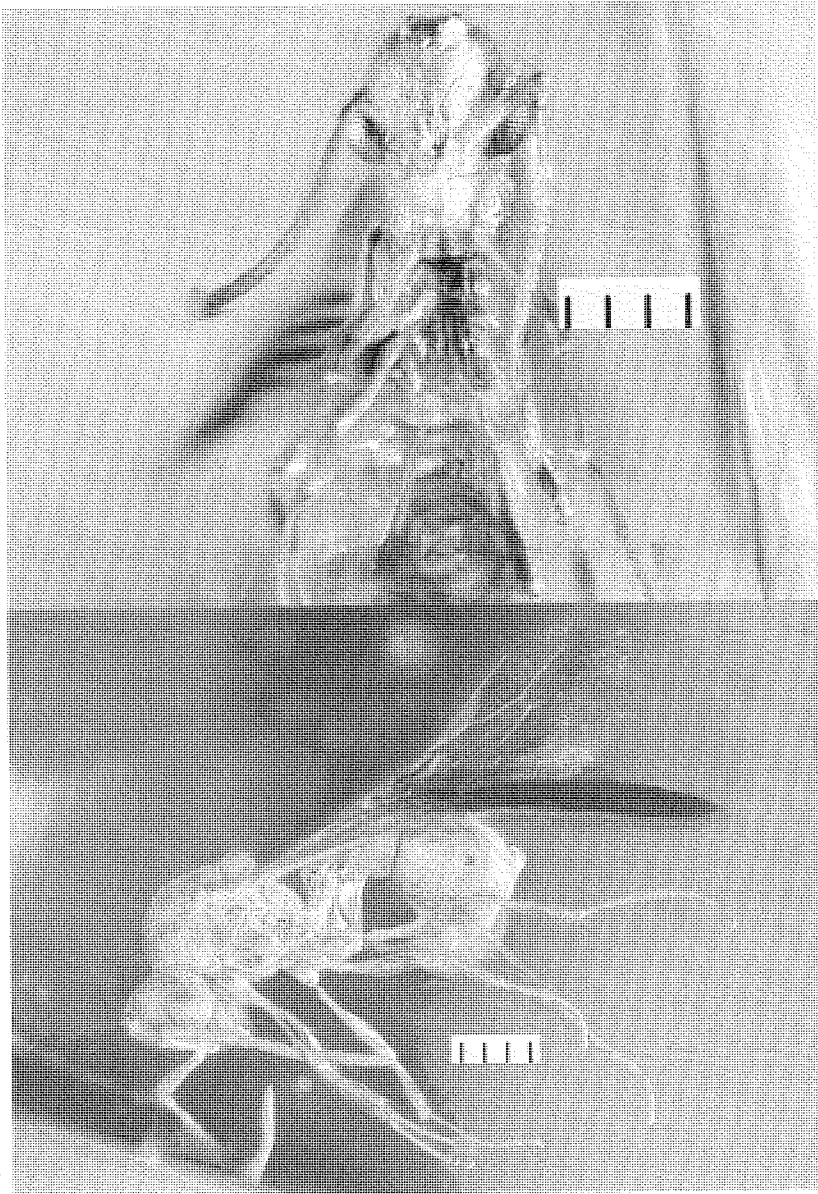


Fig. 21 – Dominican amber. Specimen PE-25-3, head in dorsal view (top), and profile of the whole specimen (bottom). Distance between two scale bars 0.1 mm.

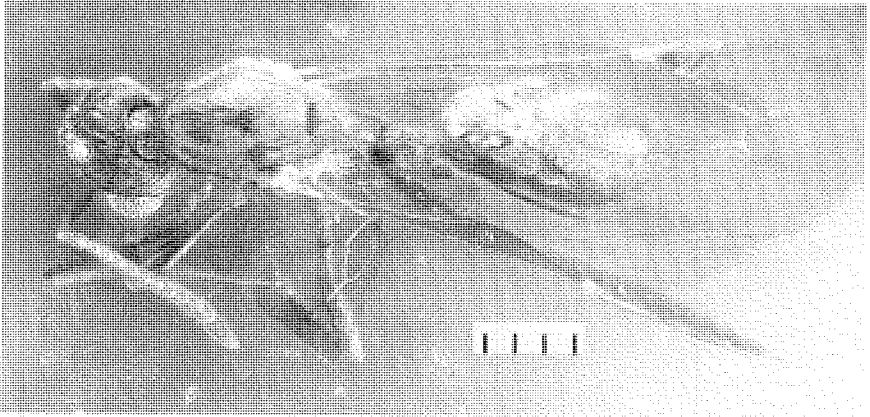


Fig. 22 – Dominican amber. Specimen PE-25-4, dorsal view. Distance between two scale bars 0.1 mm.

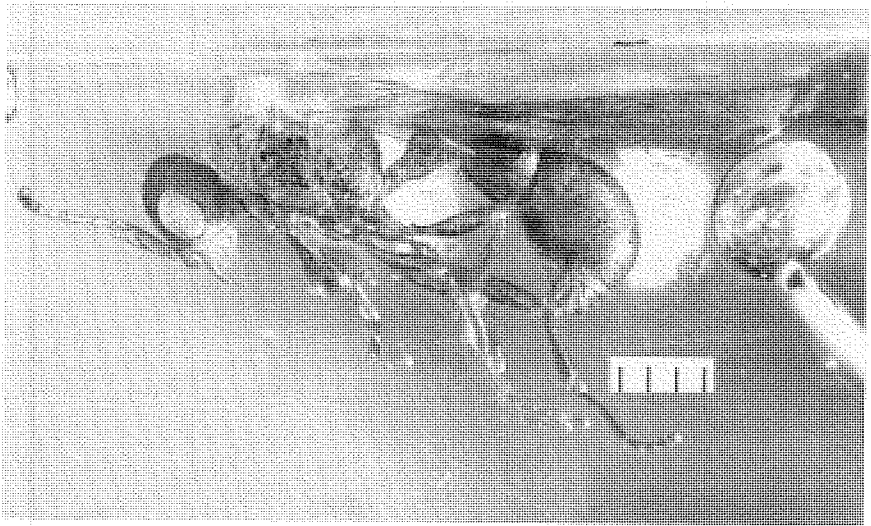


Fig. 23 – Dominican amber. Specimen PE-25-5, side view. Distance between two scale bars 0.1 mm.

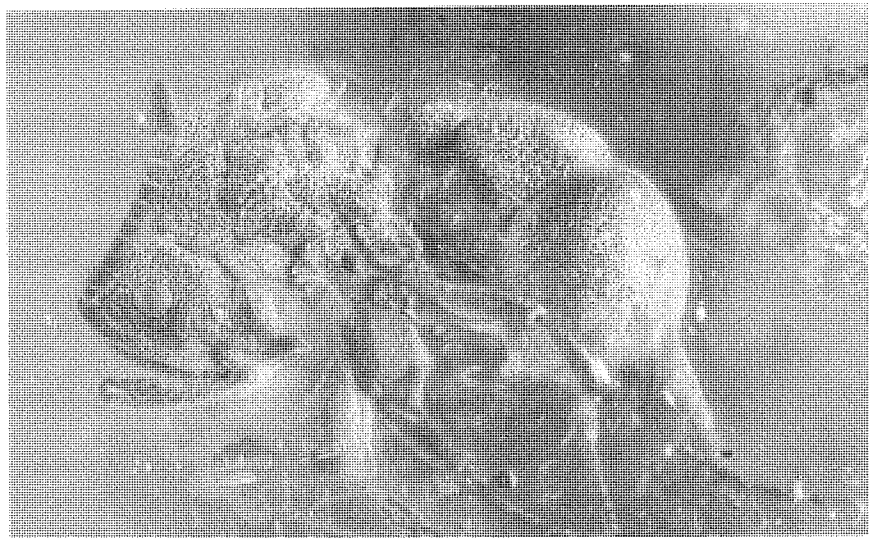


Fig. 24 – *Proceratium denticulatum* Lattke, holotype in profile.

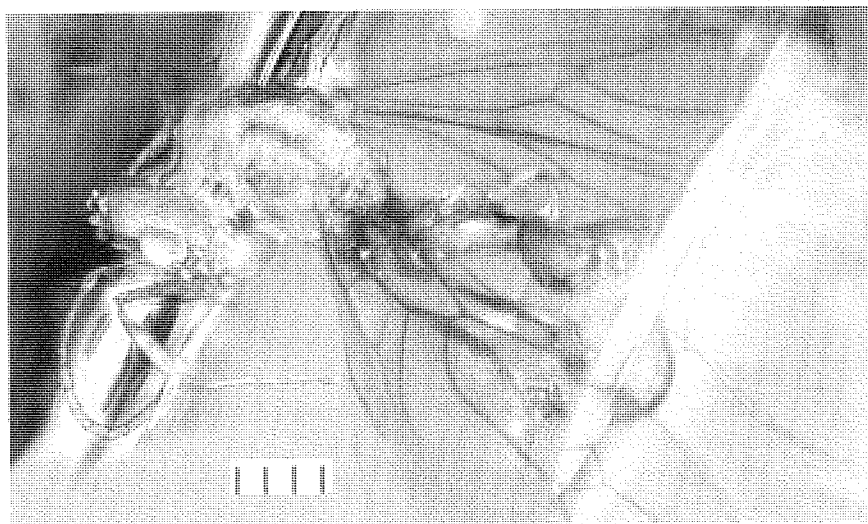


Fig. 25 – Mexican amber. Specimen H 10-197-2, side view. Distance between two scale bars 0.1 mm.

- ATCG. Alberto Tinaut Collection, Departamento de Biología Animal y Ecología, Universidad de Granada, Granada, Spain. Courtesy of Prof. Dr. Alberto Tinaut.
- BMNH. The Natural History Museum, London, UK. Courtesy of Barry Bolton.
- CASC. California Academy of Sciences, San Francisco, CA, U.S.A.  
Courtesy of Prof. Dr. Wojciech Pulawski and Dr. Robert Zuparko.
- CIRA. Centre de Coopération Internationale en Recherche Agronomique pour le Développement, Montpellier, France. Courtesy of Dr. Henri-Pierre Aberlenc.
- CPCC. Centro de Pesquisa do Cacao, CEPLAC, Itabuna, Bahia, Brasil.  
Courtesy of Dr. Jacques H. C. Delabie.
- DEIC. Deutsches Entomologisches Institut, Eberswalde, Germany. Courtesy of Dr. Stephan M. Blank.
- DIVA. Dipartimento Valorizzazione e Protezione delle Risorse Agroforestali (DI.VA.P.R.A.), Entomologia e Zoologia Applicate all'Ambiente "Carlo Vidano", Grugliasco, Torino (Coll. M. Consani). Courtesy of Prof. Dr. Alessandra Arzone and Dr. Mauro Daccordi.
- DMCM. David Mifsud Collection, Malta. Courtesy of Dr. David Mifsud.
- FSCA. Florida State Collection of Arthropods. Courtesy of Dr. Zachary Prusak.
- HNHM. Hungarian Natural History Museum, Budapest, Hungary. Courtesy of Prof. Dr. J. Papp and Dr. L. Zombori.
- IAVH. Instituto de Investigación de Recursos Biológicos Alexander von Humboldt, Villa de Leiva, Santafé de Bogotá, Colombia. Courtesy of Fernando Fernández-C.
- IEGG. Istituto Di Entomologia "Guido Grandi", Bologna, Italy. Courtesy of Prof. Egidio Mellini.
- INBC. Institute of National Biodiversity, San José, Costa Rica. Courtesy of Dr. John T. Longino.
- KOCO. Keiichi Onoyama Collection, Obihiro, Japan. Courtesy of Dr. Keiichi Onoyama.
- LACM. Natural History Museum of Los Angeles County, Los Angeles, USA. Courtesy of Roy R. Snelling.
- MCSN. Museo Civico di Storia Naturale "Giacomo Doria", Genoa, Italy.  
Courtesy of Dr. Valter Raineri.
- MCZC. Museum of Comparative Zoology, Harvard University, Cambridge, Massachusetts, USA. Courtesy of Stefan Cover.

- MEUV. Museo de Entomología de la Universidad del Valle, Cali, Colombia.  
Courtesy of Dr. Patricia Chacón.
- MHNG. Muséum d'Histoire Naturelle, Geneva, Switzerland. Courtesy of  
Dr. Ivan Löbl and Dr. Bernhard Merz.
- MIZA. Museo del Instituto de Zoología Agrícola "Francisco Fernández Yépes",  
Maracay, Venezuela. Courtesy of Dr. John Lattke and José L. García.
- MMCR. Maurizio Mei Collection, Rome, Italy. Courtesy of Maurizio Mei.
- MNHN. Muséum National d'Histoire Naturelle, Paris, France. Courtesy of  
Dr. Janine Casevitz-Weulersse.
- MRSN. Museo Regionale di Scienze Naturali, Torino, Italy. Courtesy of Dr.  
Mauro Daccordi.
- MSNM. Museo Civico di Storia Naturale di Milano, Milan, Italy. Courtesy  
of Dr. Fabrizio Rigato.
- MSNV. Museo Civico di Storia Naturale di Verona, Verona, Italy. Courtesy  
of Dr. Leonardo Latella.
- MTCN. Mamoru Terayama Collection, Naka-cho, Iwatsuki-shi, Saitama,  
Japan. Courtesy of Dr. Mamoru Terayama.
- MZSP. Museu de Zoologia, Universidade de São Paulo, Brazil. Courtesy of  
Prof. Carlos Roberto Ferreira Brandão.
- NHMB. Naturhistorisches Museum Basel, Switzerland. Courtesy of Dr.  
Michel Brancucci and Dr. Daniel Burckhardt.
- NHMW. Naturhistorisches Museum Wien, Austria. Courtesy of Dr. Stefan  
Schödl.
- UCFC. University of Central Florida Collection. Courtesy of Dr. Zachary Prusak.
- USNM. United States Department of Agriculture, Agricultural Research Ser-  
vice, Systematic Entomology Laboratory, c/o National Museum of Natu-  
ral History, Washington, D. C., USA. Courtesy of Dr. Ted R. Schultz.
- WEMC. William and Emma MacKay Collection, El Paso, Texas, United  
States. Courtesy of Prof. William P. MacKay.
- ZMBC. Zoologisches Museum an der Humboldt-Universität zu Berlin,  
Berlin, Germany. Courtesy of Dr. F. Koch and Annette Kleine-Möllhoff.
- We made an effort to illustrate (through the talent of Armin Coray) the  
male genitalia of as many species as possible. This structure is virtually  
ignored by most myrmecologists. The number of *Proceratium* species for  
which the male is known is still too small to allow the drawing of phyloge-  
netic hypotheses based on these structures alone. The *Proceratium* genitals  
nonetheless show characters of paramount importance in separating the

species. Due to the small size of the *Proceratium* genitals some sclerites were deformed or slightly damaged during the dissection. They have been 'repaired' or restored in the illustrations accompanying this paper.

The photographs illustrating all the fossil species and three Recent ones known from one or a few specimens in bad shape are a patchwork of several different pictures. These result from the combination of the sharpest area of each individual picture. Merging together the best areas of different pictures was performed automatically by the software Montage Explorer, Version 1.01.003 (© Synoptics Ltd, 1998, 1999).

Given the uniqueness of part of the material on which the present study is based, a number of SEM photographs were taken without coating the specimen.

Measurements and Indices are basically those already defined by Snelling & Cover (1992) plus a few additional ones defined here. They are as follows:  
EL= Eye length: maximum length of the eye.

HL= Head length: the maximum measurable distance between the medial margin of vertex and the anteromedial margin of clypeus with the head in full frontal view.

HW= Head width: maximum head width behind the eyes with the head in full frontal view.

HTiL= Maximum length of hind tibia measured on its external face.

HFeL= Maximum length of hind femur measured on its external face.

HBaL= Maximum length of hind basitarsus measured on its external face.

LS4= Maximum length of abdominal sternum IV in lateral view as already defined by Ward (1988).

LT4= Length of abdominal tergum IV in lateral view as already defined by Ward (1988).

PeL= Maximum length of petiole in dorsal view including its anterolateral prolongation.

PeW= Transversal width of the petiole in dorsal view measured on its broadest part.

SL= Scape Length: length of scape shaft, excluding the basal condyle.

TL= Total Length: combined head length in full face view (closed mandibles included), Weber's length of mesosoma, petiole length (in dorsal view), postpetiole length (in side view) and length of gastral tergum 2 (in side view).

WL= Weber's Length: diagonal length of mesosoma from the anterior pronotal slope to the distal edge of the propodeal lamellae or lobes.



CI= Cephalic index:  $(HW/HL)(100)$ .

IGR= "Index of Gastral Reflexion": length of gastral sternum I/length of gastral tergum I (sternum and tergum II of Ward, 1988). This is, however, a ratio and not an index, and its value increases with decreasing gastral reflexion.

SI= Scape index:  $(SL/HL)(100)$ .

## TERMINOLOGY

We regard the abdominal segment III of *Proceratium* as a true postpetiole however broad it might be. Hence, while dealing with gastral segment I or with the gaster, in our text, we refer always to abdominal segment IV or to segments IV-VII.

We would like to insist on the pertinent use of some earlier terms available in the ant literature and already stressed by de Andrade & Baroni Urbani (1999). There are no soldiers in *Proceratium* and the sole two female castes should be properly termed as workers and gynes. The latter caste is also called "queen" in the ant literature. Use of this term leads to the drawbacks already listed in our 1999 paper and to self-contradictory expressions like "winged queen". A true queen is always wingless, of course.

Use of the term gyne, in addition, is consistent with the standard use of other universally employed terms such as microgyne, ergatogyne, gynandromorph, etc. which, fortunately, nobody ever called "microqueen", "ergatqueen" or "queenandromorph".

In this paper, within the gyne caste and for practical purpose, we distinguish true gynes from the following two additional subcastes encountered while studying *Proceratium* material:

Ergatoid [ergatogyne (Wasmann, 1895)], also called "ergatomorphic or ergatoid female, is a worker-like form, with ocelli, large eyes and a thorax more or less like that of the female, but without wings" (Wheeler, 1910).

Sub-ergatoid, a term introduced here to designate worker individuals with larger eyes and traces of ocelli.

The reason for the distinction lies on the fact that the worker morphology, including measurements and indices, can be largely inferred from sub-ergatoids while this is not the case for ergatoids.

The nomenclature adopted here is consistent with the one proposed by Peeters (1991) although, of course, while dealing with isolate museum specimens, we are unable to stress the physiological differences.

## LIST OF CHARACTERS

The synapomorphy hypotheses that we were able to formulate and to retain during the present study are the following:

1. Worker. Eyes composed by an agglomeration of salient ommatidia (Fig. 26) (0), or by a single convex facet (e. g. Fig. 43) (1), or absent or at most represented by a small agglomeration of minute, flat ommatidia (e. g. Fig. 98) (2).
2. Worker. Vertexal angles without a round or oval macula visible in transparency (0), or with such a macula (Fig. 125) (1).
3. Worker. Head sides diverging or subparallel and at most slightly convex posteriorly (e. g. Figs. 48 & 78) (0), or strongly narrowing and convex posteriorly (Figs. 86, 90 & 91) (1).
4. Worker. HL (mandibles excluded)  $\leq 1.18$  mm (0), or HL (mandibles excluded)  $\geq 1.25$  mm (1).

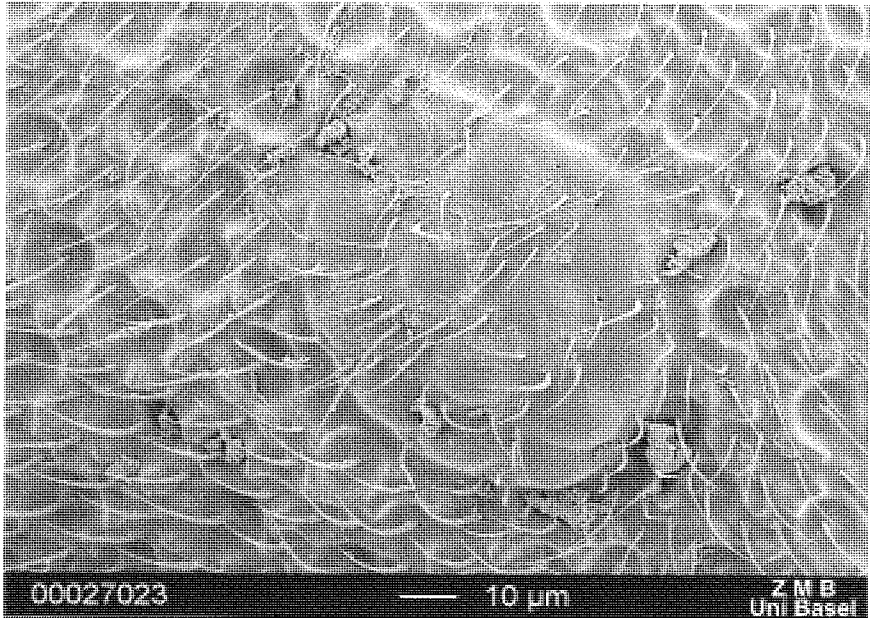


Fig. 26 – *Discothyrea* sp. Worker from Bunya Mountains, Queensland, Australia: eye.

5. Worker. Propodeum without a dorsal median protuberance (Figs. 37, 67 & 108) (0), or with such a protuberance (Figs. 55, 56 & 61) (1).
6. Worker. Propodeum without traces of a transversal sulcus (0), or with a marked transverse sulcus or at least with well-visible traces of it (1).
7. Worker. Propodeal teeth absent or of different shape, but never blunt, with base broadening in all directions (0), or blunt, with a broad base (1).
8. Worker. Sides of the declivous face of the propodeum not surrounded by a round, semi-membranaceous lamella (Figs. 65 & 136) (0), or surrounded by a round, semi-membranaceous lamella (Figs. 86 & 91) (1).
9. Worker. Mesosoma with long and short hairs over the whole surface (0), or equally with two types of hairs but only with short hairs over the basal face of the propodeum (1). Species with only one type of hairs over the mesosoma coded as "?".
10. Worker. Lower mesopleurae not inflated (Figs. 48 & 101) (0), or inflated (Figs. 121 & 122) (1).
11. Worker. Postpetiole without (0), or with a lighter macula visible in transparency through the integument (1).
12. Worker and gyne. Antennal fossae slightly behind the anterior border of clypeus (0), or surpassing the anterior border of the clypeus (1).
13. Worker and gyne. Clypeus either strongly protruding anteriorly and round (0), or strongly protruding anteriorly but never notched or crenulate (1), or strongly protruding anteriorly, and medially notched or crenulate (2), or protruding anteriorly and rectangular (3), or protruding anteriorly and triangular (4), or almost straight and weakly crenulate (5), or straight and/or weakly concave (6).
14. Worker and gyne. Frontal carinae clearly separate from each other posteriorly (0), or very close or touching each other (1).
15. Worker and gyne. Area behind the frontal carinae without (0) or with a protuberance (1).
16. Worker and gyne. First funicular joint shorter than 1/2 of its width (0), or 1/2 longer than broad (1).
17. Worker and gyne. Funicular joints 2-9 broader than long (0) or about as broad as long or much longer than broad (1).
18. Worker and gyne. Last funicular joint at least 3/4 as long as the sum of the remaining joints (Fig. 27) (0), or much shorter than the sum of the remaining joints (1).

19. Worker and gyne. Palp formula 5,4 (0), or 5,3 (1), or 4,4 (2), or 4,3 (3), or 3,3 (4), or 3,2 (5), or 2,2 (6). The character state for *Bradoponera meieri* is coded after Mayr (1868).
20. Worker and gyne. Mandibles edentate (0), or with at least 3 small denticles (1).
21. Worker and gyne. Mandibular base without light macula (0), or with a light lateral macula (1) (Fig. 28).
22. Worker and gyne. Head in profile ventrally weakly convex to flat (0), or clearly convex (1).
23. Worker and gyne. Head without genal carinae and/or sulcus (0), or with genal carinae and/or sulcus (1).
24. Worker and gyne. Gular area not deeply concave (0), or deeply concave (1). This character was coded as '?' for *P. foveolatum* since we did not succeed in relaxing the sole known specimen in a way allowing satisfactory examination.

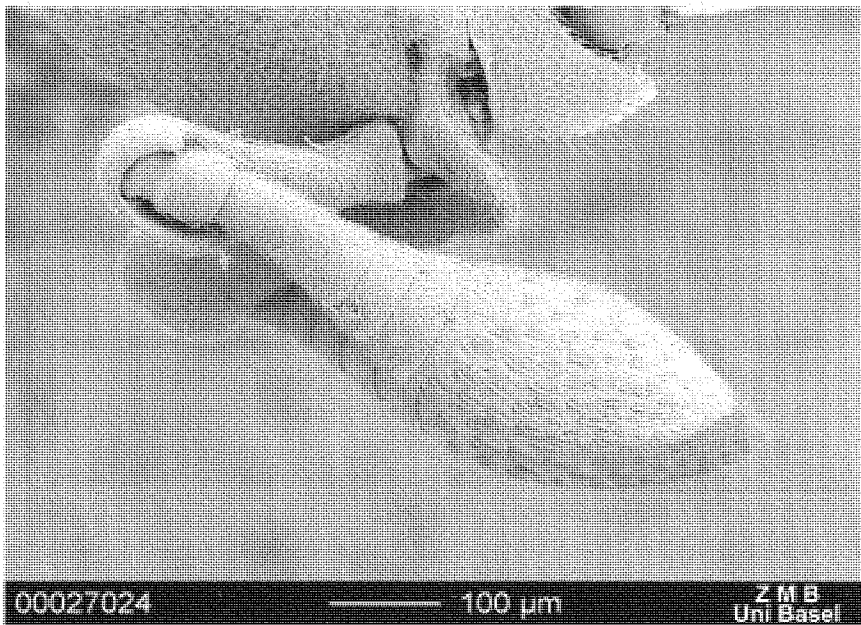


Fig. 27 – *Discothyrea* sp. Worker from Bunya Mountains, Queensland, Australia: antenna.

25. Worker and gyne. Propodeal lobes small and never lamellaceous (Figs. 58 & 139) (0), or large and lamellaceous (Figs. 42 & 48) (1). Species with propodeal lamellae surrounding the lobe (character 8) were coded as “?”.
26. Worker and gyne. Petiole never dorsally compressed (Figs. 34 & 100) (0), or petiole dorsally compressed (Figs. 126 & 127) (1).
27. Worker and gyne. Petiole without neck (0), or with a distinct neck (1).
28. Worker and gyne. Postpetiole in dorsal view of different shape but never concave and laterally lobate (0), or postpetiole in dorsal view with anterior face concave and laterally lobate (1).
29. Worker and gyne. Postpetiole much longer than the first gastral tergite (0), or postpetiole shorter than the first gastral tergite (1).
30. Worker and gyne. First gastral tergite without angle on the curvature (Figs. 52 & 78) (0), or with a visible angle on the curvature (Figs. 48 & 93) (1). *P. diplopyx* (Fig. 35) was coded as “0” since we do not regard its unique gastral structure as comparable with the angle present in other species.

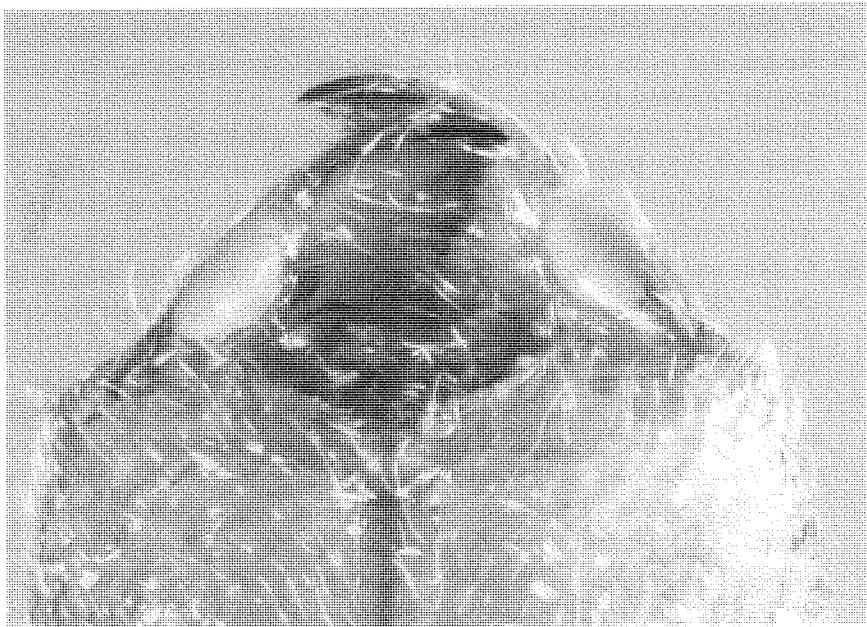


Fig. 28 – *Proceratium croceum* (Roger). Worker. Mandibles and part of the cephalic capsule in ventral view showing the mandibular “macula”.

31. Worker and gyne. First gastral tergite with a clearer macula visible in transparency posteriorly (0), or without transparent macula posteriorly (1). This 'macula' is likely to represent the reservoir of a still undescribed gland.
32. Worker and gyne. First gastral sternite not protruding on the postpetiolar sternite (0), or protruding on the postpetiolar sternite medially (1).
33. Worker and gyne. Posterior border of the first gastral tergite not folded (0), or folded (Fig. 3) (1). Species coded as "1" for this character, in dorsal view, appear to have one additional abdominal segment. The probable function of this false segment appears to be one of protecting the opening of the undescribed gland already mentioned under character 31.
34. Worker and gyne.  $IGR \leq 0.29$  (0), or  $IGR \geq 0.31$  (1).
35. Worker, gyne and male. Maxillary palps normally elongate (0), or with the second joint hammer-shaped (1).
36. Worker, gyne and male. Spurs of fore tibiae without basal spine (Fig. 155) (0), or with (Fig. 38) basal spine (1).
37. Worker, gyne and male. Mid tibiae without spurs (0), or with spurs (1).
38. Worker and gyne. Mid basitarsus shorter than fore basitarsus (0), or as long as or longer than the fore basitarsus (1).
39. Worker and gyne. Mid basitarsus without long hairs (0), or with hairs about 1/2 of its length (1), or with hairs about 2/3 of its length (2).
40. Worker and gyne. Hind basitarsus without long hairs (0), or with hairs about 1/2 of its length (1), or with hairs longer than half of its length (2).
41. Worker and gyne. Second tarsomere of the hind legs as long as or shorter than pretarsus (0), or second hind tarsomere 1/5 longer than the pretarsus (1).
42. Worker and gyne. Arolia small to absent (0), or large and well visible (1).
43. Worker and gyne. Head, mesosoma, petiole and postpetiole not smooth and foveolate (0), or head, mesosoma, petiole and postpetiole smooth and foveolate (1). This character was scored for both female castes for the purpose of the cladistic analysis in spite of the fact that a number of species is known on the worker caste or on the gyne caste only. We dared this extrapolation on the base of our experience on *Proceratium*: we don't know a single case of significant sculptural differences between the two castes of the same species.
44. Worker. Cephalic sculpture not granulated (Figs. 42, 101 & 127) (0), or

- sharply granulated (Figs. 108, 111 & 116). Species with foveolate head (character 43) were coded as “?”.
45. Worker and gyne. Mesosoma not granulated (e. g. Figs. 48, 100 & 127) (0), or mesosoma deeply granulated as in Figs. 108, 111 & 116 (1). Species with foveolate mesosoma (character 43) were coded as “?”.
  46. Worker and gyne. Petiole not granulated (0), or deeply granulated (1). Species with foveolate petiole (character 43) were coded as “?”.
  47. Worker and gyne. Postpetiole not granulated (0), or postpetiole deeply granulated (1). Species with foveolate postpetiole (character 43) were coded as “?”.
  48. Worker and gyne. Gaster never foveolate-rugulose (0), or clearly foveolate-rugulose (1).
  49. Worker and gyne. Integument of abdominal tergum IV never granulate (0), or granulate only after the curve (1), or granulate over its entire surface (2).
  50. Gyne. EL 1/5 or more of HL (0), or EL 1/6 or 1/7 of HL (1). The sole known *avioide* specimen with some gyne characters is likely to be an ergatoid. We preferred to code it “?” for this character.
  51. Gyne. HBaL  $\leq 0.75$  mm (0), or HBaL  $\geq 0.81$  mm (1).
  52. Gyne and male. Fore wings with *r-m* and *Mf4* absent (0) (Fig. 46) or present (1) (Fig. 50).
  53. Gyne and male. Fore wings *m-cu* absent (Fig. 55) (0), or present but small (Fig. 50) (1), or *m-cu* present and large (Fig. 102) (2).
  54. Gyne and male. Fore wings without (Fig. 76) (0), or with *Rsf3* (Fig. 96) (1).
  55. Male. Funicular joints without long hairs (0), or funicular joints with long hairs (1).
  56. Male. Mandibles edentate (0), or dentate (1).
  57. Male. Palp formula 5,3 (0), or 5,2 (1), or 4,3 (2), or 3,2 (3).
  58. Male. Petiole less than 1/6 longer than broad (0), or at least 1/6 or more longer than broad (1).
  59. Male. IGR  $\leq 0.40$  (0), or IGR  $> 0.53$  (1).
  60. Male. Aedeagus apically bidenticulate (0), or differently shaped (1).
  61. Male. External parameres without visible transversal suture (0), or with a suture visible only in the ventral half (1), or with a suture over the whole lateral surface (2).
  62. Male. External parameres round or truncated apically (0), or with an apical concavity (1).

## DATA MATRIX

All characters were assumed to be unordered. As already suggested by de Andrade & Baroni Urbani (1999), to avoid overweighing of possible sex- or caste-independent characters analysed separately for two sexes or for two castes, these characters were assigned weight 1 and all other characters were weighted 2.

The scores of the different characters for each species and for the outgroups are given in Tab. I.

## CLADISTIC ANALYSIS

A species-level cladistic analysis of *Proceratium* was performed using as outgroups three representatives of the closely related genus *Discothyrea* and two of the extinct, Baltic amber genus *Bradoponera*. *Discothyrea* and *Bradoponera* are, together with *Proceratium*, the sole known members of the tribe Proceratiini. No straightforward autapomorphies have been included in the data matrix. The search for the most parsimonious tree(s) was performed by PAUP 4.0b2a (Swofford, 1998 and following updates). The graphic tracing of character evolution of Figs. 170 & 171 was obtained by MacClade 3.01 (Maddison & Maddison, 1992).

Since our species-level analysis included all known *Proceratium* species and representatives of the other two Proceratiini genera, it allowed also a precise definition of the genus *Proceratium*. We give it in the following.

### Genus **Proceratium** Roger

*Proceratium* Roger, 1863: 171. Type species *Proceratium silaceum* Roger, by monotypy.

*Sysphingta* Roger, 1863: 175. Type species *Sysphingta micrommata* Roger, by monotypy. Synonymy with *Proceratium* by Mayr, 1886: 437.

*Sysphincta* (sic) Roger, Mayr, 1865: 12. Incorrect spelling.

*Sysphincta* (sic) Roger, Emery, 1895: 262, emended.

*Proceratium* subgenus *Sysphincta*, Forel, 1913: 212.

*Proceratium* Roger, Borgmeier, 1957: 117. Senior synonym of *Sysphingta* and *Sysphincta*, reinstated.



Tab. I a - Matrix with the coding and weights of the characters described in the text for the species of *Proceratium* and for the outgroups. Species *al-giricum* to *hirsutum*. Characters 1-20.

Characters	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Weight	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	1	2
<i>al-giricum</i>	2	0	1	0	0	0	0	1	0	0	0	0	3	0	0	0	1	0	3	1
<i>angulinode</i>	2	0	0	0	0	0	0	0	0	0	0	1	6	0	0	0	0	0	6	1
<i>arnoldi</i>	2	1	0	0	0	0	0	0	0	1	1	1	5	0	0	0	0	0	5	1
<i>australe</i>	2	0	0	0	0	0	0	0	0	0	0	1	6	0	0	0	0	0	6	1
<i>austronesicum</i>	2	0	0	0	0	0	0	0	0	0	0	1	6	0	0	0	0	0	6	1
<i>avium</i>	1	0	0	0	0	0	0	0	0	0	0	1	2	0	0	0	1	0	3	1
<i>avioide</i>	1	0	0	0	0	0	0	0	0	0	0	1	2	0	0	0	1	0	3	1
<i>banjaranense</i>	2	0	0	0	0	0	0	0	0	0	0	1	6	0	0	0	0	0	6	1
<i>bhutanense</i>	2	0	0	0	0	0	0	1	?	0	0	1	4	0	0	0	0	0	5	1
<i>boltoni</i>	1	0	0	0	0	0	0	0	0	0	0	1	2	0	0	0	0	0	3	1
<i>brasiliense</i>	1	0	0	0	1	1	0	0	1	0	0	1	4&5	0	1	0	0	0	5	1
<i>burundense</i>	0	1	0	0	0	0	0	0	0	1	1	1	5	0	0	0	0	0	5	1
<i>caledonicum</i>	2	0	0	0	0	0	0	0	0	0	0	1	6	0	0	0	0	0	6	1
<i>californicum</i>	2	0	0	0	0	0	0	0	?	0	0	0	4	0	0	0	1	0	3	1
<i>catio</i>	1	0	0	0	1	1	0	0	1	0	0	1	4&5	0	1	0	0	0	5	1
<i>cavinodus</i>	1	0	0	0	0	0	0	0	0	0	0	1	2	0	0	0	0	0	3	1
<i>chickasaw</i>	2	0	0	0	0	0	0	1	0	0	0	0	3	0	0	0	0&1	0	3	1
<i>colombicum</i>	1	0	0	0	1	1	0	0	1	0	0	1	4&5	0	1	0	0	0	5	1
<i>compitale</i>	2	0	1	0	0	0	0	1	0	0	0	0	3	0	0	1	1	0	3	1
<i>confinium</i>	2	0	0	0	0	0	0	0	0	0	0	1	4	0	0	1	1	0	?	1
<i>convexiceps</i>	1	0	0	0	0	1	0	0	0	0	0	1	4&5	0	1	0	0	0	5	1
<i>crassicorne</i>	2	0	0	0	0	0	0	0	0	0	0	1	6	0	0	0	0	0	6	1
<i>creek</i>	2	0	1	0	0	0	0	1	0	0	0	0	3	0	0	1	1	0	3	1
<i>croceum</i>	2	0	0	0	0	0	0	0	0	0	0	1	6	0	0	0	0	0	6	1
<i>cubanum</i>	1	0	0	0	0	1	0	0	0	0	0	1	4&5	0	1	0	0	0	5	1
<i>dayak</i>	2	0	0	0	0	0	0	0	0	0	0	1	6	0	0	0	0	0	6	1
<i>deelemani</i>	1	0	0	0	0	0	0	0	0	0	0	1	2	0	0	0	0	0	3	1
† <i>denticulatum</i>	?	?	?	?	?	?	?	?	?	?	?	1	2	0	0	0	1	0	?	1
<i>diplopyx</i>	1	0	0	1	0	0	0	0	0	0	0	1	2	0	0	0	1	0	3	1
† <i>dominicanum</i>	?	?	?	?	?	?	?	?	?	?	?	?	4&5	0	1	0	0	0	5	1
<i>dusun</i>	2	0	0	0	0	0	0	0	0	0	0	1	6	0	0	0	0	0	6	1
<i>ecuadoriense</i>	1	0	0	0	0	1	0	0	1	0	0	1	4&5	0	1	0	0	0	5	1
<i>foveolatum</i>	1	0	0	0	0	0	0	0	0	0	0	1	2	0	0	0	0	0	?	1
<i>galilaeum</i>	2	1	0	0	0	0	0	0	0	0	1	1	5	0	0	0	0	0	?	1
† <i>gibberum</i>	?	?	?	?	?	?	?	?	?	?	?	?	2	0	0	0	1	0	3	1
<i>gigas</i>	2	0	0	0	0	0	0	0	0	0	0	1	6	0	0	0	0	0	6	1
<i>goliath</i>	1	0	0	1	0	0	0	0	0	0	0	1	2	0	0	0	0	0	3	1
<i>gracile</i>	2	0	0	0	0	0	0	0	0	0	0	1	6	0	0	0	0	0	6	1
<i>hirsutum</i>	2	0	0	0	0	0	0	0	0	0	0	1	6	0	0	0	0	0	6	1

Tab. I b - Matrix with the coding and weights of the characters described in the text for the species of *Proceratium* and for the outgroups. Species *algiricum* to *hirsutum*. Characters 21-41.

Characters	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41
Weight	2	2	2	2	1	2	2	2	2	2	2	2	2	1	2	2	2	2	2	2	2
<i>algiricum</i>	0	1	1	0	?	0	1	0	0	0	1	0	0	1	1	1	0	1	0	0	1
<i>angulinode</i>	1	0	0	0	0	0	0	1	0	0	0	0	1	1	1	0	0	0	2	2	0
<i>arnoldi</i>	0	0	0	0	0	0	1	0	0	0	0	0	0	1	1	0	0	0	0	0	0
<i>australe</i>	1	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	2	1	0
<i>austronesicum</i>	1	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	2	1	0
<i>avium</i>	0	0	0	0	0	0	1	0	0	0	1	0	0	0	1	1	0	1	0	0	0
<i>avioide</i>	0	0	0	0	0	0	1	0	0	0	1	0	0	0&1	1	1	0	1	0	0	0
<i>banjaranense</i>	1	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	2	2	0
<i>bhutanense</i>	0	1	0	0	?	0	1	0	0	0	1	1	0	1	1	0	0	0	0	0	0
<i>boltoni</i>	0	0	0	0	0	0	1	0	0	0	1	0	0	0	1	1	0	0	0	0	0
<i>brasiliense</i>	0	0	0	0	0	0	1	0	0	0	1	0	0	0	1	0	1	0	1	0	0
<i>burundense</i>	0	0	0	0	0	0	1	0	0	0	0	0	0	1	1	0	0	0	0	0	0
<i>caledonicum</i>	1	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	2	1	0
<i>californicum</i>	0	1	1	0	0	0	1	0	0	0	1	0	0	1	1	1	0	1	0	0	1
<i>catio</i>	0	0	0	0	0	0	1	0	0	0	1	0	0	0	1	0	1	0	1	0	0
<i>cavinodus</i>	0	0	0	0	0	0	1	0	0	0	1	0	0	0	1	1	0	0	0	0	0
<i>chickasaw</i>	0	1	1	0	?	0	1	0	0	1	1	0	0	0	1	1	0	0	0	0	1
<i>colombicum</i>	0	0	0	0	0	0	1	0	0	0	1	0	0	0	1	0	1	0	1	0	0
<i>compitale</i>	0	1	1	0	?	0	1	0	0	1	1	0	0	0&1	1	1	0	1	0	0	1
<i>confinium</i>	0	0	1	0	0	0	1	0	0	0	1	0	0	1	1	1	0	1	0	0	1
<i>convexiceps</i>	0	0	0	0	0	0	1	0	0	0	1	0	0	0	1	0	1	0	1	0	0
<i>crassicorne</i>	1	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0&1	0	0
<i>creek</i>	0	1	1	0	?	0	1	0	0	1	1	0	0	1	1	1	0	1	0	0	1
<i>croceum</i>	1	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0
<i>cubanum</i>	0	0	0	0	0	0	1	0	0	0	1	0	0	0	1	0	1	0	0	0	0
<i>dayak</i>	1	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	1	0	0
<i>deelemani</i>	0	0	0	1	1	0	1	0	0	0	1	0	0	0	1	1	0	0	1	0	0
† <i>denticulatum</i>	0	0	0	0	0	0	1	0	0	0	?	0	0	0	1	1	0	0	0	0	0
<i>diplopyx</i>	0	0	0	0	0	0	1	0	0	0	1	0	0	0	1	1	0	1	0	0	0
† <i>dominicanum</i>	0	0	0	0	0	0	1	0	0	0	?	0	0	0	1	0	1	0	0	0	0
<i>dusun</i>	1	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	2	2	0
<i>ecuadoriense</i>	0	0	0	0	0	0	1	0	0	0	1	0	0	0	1	0	1	0	1	0	0
<i>foveolatum</i>	0	0	0	?	1	0	1	0	0	1	1	0	0	0	1	1	0	0	0	0	0
<i>galilaenum</i>	0	0	0	0	0	0	1	0	0	0	0	0	0	1	1	0	0	0	0	0	0
† <i>gibberum</i>	0	0	0	0	0	0	1	0	0	1	?	0	0	0	1	1	0	1	0	0	0
<i>gigas</i>	1	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0
<i>goliath</i>	0	0	0	1	0	0	1	0	0	0	1	0	0	0	1	1	0	0	0	0	0
<i>gracile</i>	1	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0
<i>hirsutum</i>	1	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	1	0	0



Tab. I d - Matrix with the coding and weights of the characters described in the text for the species of *Proceratium* and for the outgroups. Species *itoi* to *Bradoponera meieri*. Characters 1-20.

Characters	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20		
Weight	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	1	2		
<i>itoi</i>	2	0	0	0	0	0	0	0	0	0	0	0	1	4	0	0	0	0	0	3	1	
<i>ivimka</i>	2	0	0	0	0	0	0	0	0	0	0	0	1	6	0	0	0	0	0	6	1	
<i>japonicum</i>	2	0	0	0	0	0	0	0	0	0	0	0	1	6	0	0	0	0	0	6	1	
<i>latkei</i>	1	0	0	0	0	1	0	0	0	0	0	0	1	4	0	0	0	0	0	5	1	
<i>lombokense</i>	?	?	?	?	?	?	?	?	?	?	?	?	1	6	0	0	0	0	0	6	1	
<i>longiscapus</i>	?	?	?	?	?	?	?	?	?	?	?	?	1	4&5	0	1	1	1	0	5	1	
<i>lunatum</i>	2	1	0	0	0	0	0	0	0	1	1	1	1	5	0	0	0	0	0	5	1	
<i>malesianum</i>	2	0	0	0	0	0	0	1	0	0	0	1	4	0	0	0	0	0	0	5	1	
<i>mancum</i>	2	0	0	0	0	0	0	0	0	0	0	0	1	6	0	0	0	0	0	6	1	
<i>melinum</i>	2	0	0	0	0	0	0	0	0	0	0	0	1	4	0	0	0	0	0&1	0	3	1
<i>melitense</i>	2	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	1	0	3	1	
<i>mexicanum</i>	1	0	0	0	0	1	0	0	0	0	0	0	1	4&5	0	1	0	0	0	5	1	
<i>micrommatum</i>	1	0	0	0	0	1	0	0	0	0	0	0	1	4&5	0	1	0	0	0	5	1	
<i>microsculptum</i>	2	0	0	0	0	0	0	1	0	0	0	1	2	1	0	1	0	0	0	3	1	
<i>morisitai</i>	2	0	0	0	0	0	0	0	0	0	0	0	1	4	0	0	0	0	0&1	0	3	1
<i>numidicum</i>	2	0	0	0	0	0	0	0	0	0	0	0	1	6	0	0	0	0	0	6	1	
<i>oceanicum</i>	2	0	0	0	0	0	0	0	0	0	0	0	1	6	0	0	0	0	0	6	1	
<i>panamense</i>	1	0	0&1	0	0	1	0	0	0	0	0	0	1	4&5	0	1	0	0	0	5	1	
<i>papuanum</i>	2	0	0	0	0	0	0	0	0	0	0	0	1	6	0	0	0	0	0	6	1	
<i>pergandei</i>	2	0	0	0	0	0	0	1	0	0	0	0	0	3	0	0	0	0	0&1	0	3	1
† <i>poinari</i>	1	?	0	0	0	1	0	0	0	0	0	0	1	4&5	0	1	0	0	0	5	1	
<i>politum</i>	2	0	0	0	0	0	0	0	0	0	0	0	1	6	0	0	0	0	0	6	1	
<i>pumilio</i>	2	0	0	0	0	0	0	0	0	0	0	0	1	6	0	0	0	0	0	6	1	
<i>relictum</i>	2	0	0	0	0	0	0	0	0	0	0	0	1	6	0	0	0	0	0	6	1	
<i>robustum</i>	2	0	0	0	0	0	0	0	0	0	0	0	1	6	0	0	0	0	0	6	1	
<i>siamense</i>	2	0	0	0	0	0	0	0	0	0	0	0	1	6	0	0	0	0	0	6	1	
<i>silaceum</i>	2	0	0	0	0	0	0	0	0	0	0	0	1	6	0	0	0	0	0	6	1	
<i>snellingi</i>	2	0	0	0	0	0	0	0	0	0	0	0	1	6	0	0	0	0	0	6	1	
<i>stictum</i>	1	0	0	0	0	0	0	0	0	0	0	0	1	2	0	0	0	0	0	3	1	
<i>striativenter</i>	2	0	0	0	0	0	0	0	0	0	0	0	1	6	0	0	0	0	0	6	1	
<i>sulawense</i>	2	0	0	0	0	0	0	0	0	0	0	0	1	6	0	0	0	0	0	6	1	
<i>taino</i>	1	0	0	0	0	1	0	0	0	0	0	0	1	4&5	0	1	0	0	0	5	1	
<i>terraealtae</i>	2	0	0	0	0	0	0	0	0	0	0	0	1	6	0	0	0	0	0	6	1	
<i>terroni</i>	2	0	0	0	0	0	1	0	?	0	0	1	5	1	0	0	0	0	0	5	1	
<i>tio</i>	1	0	0	1	0	0	0	0	0	0	0	0	1	2	0	0	0	0	0	3	1	
<i>toschii</i>	?	0	0	0	0	0	1	0	0	0	0	0	1	5	1	0	0	0	0	?	1	
<i>transitonis</i>	1	0	0	0	1	1	0	0	0	0	0	1	2	0	0	0	0	0	0	5	1	
<i>watasei</i>	2	0	1	0	0	0	1	0	0	0	0	0	0	3	0	0	0	1	0	3&4	1	
† <i>Discothyrea gigas</i>	0	0	0	0	0	0	0	0	?	0	0	1	1	0	0	0	0	0	1	2	0	
<i>Discothyrea sculptor</i>	0	0	0	0	0	0	0	0	?	0	0	1	1	0	0	0	0	0	1	?	0	
<i>Discothyrea stumperi</i>	0	0	0	0	0	0	0	0	?	0	0	1	1	0	0	0	0	0	1	1	0	
† <i>Bradoponera sp.</i>	?	?	?	?	?	?	?	?	?	?	?	?	0	0	0	0	0	0	0	1	?	0
† <i>Bradoponera meieri</i>	0	0	0	0	0	0	0	0	?	0	0	0	0	0	0	0	0	0	1	0	0	

Tab. I e - Matrix with the coding and weights of the characters described in the text for the species of *Proceratium* and for the outgroups. Species *itoi* to *Bradoponera meieri*. Characters 21-41.

Characters	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41
Weight	2	2	2	2	1	2	2	2	2	2	2	2	2	1	2	2	2	2	2	2	2
<i>itoi</i>	0	1	0	0	0	0	1	0	0	0	1	1	0	1	1	0	0	0	0	0	0
<i>ivimka</i>	1	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	2	1	0
<i>japonicum</i>	1	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	1	0	0
<i>latkei</i>	0	0	0	0	0	0	1	0	0	0	1	0	0	0	1	0	0	0	1	0	0
<i>lombokense</i>	1	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	?	?	0
<i>longiscapus</i>	0	0	0	0	0	0	1	0	0	0	1	0	0	0	1	0	1	0	0	0	0
<i>lunatum</i>	0	0	0	0	0	0	1	0	0	0	0	0	0	1	1	0	0	0	0	0	0
<i>malesianum</i>	0	1	0	0	?	0	1	0	0	0	1	1	0	1	1	0	0	0	1	0	0
<i>mancum</i>	1	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	2	1	0
<i>melinum</i>	0	1	1	0	0	0	1	0	0	0	1	0	0	1	1	1	0	0	0	0	1
<i>melitense</i>	0	1	1	0	?	0	1	0	0	0	1	0	0	1	1	1	0	1	0	0	1
<i>mexicanum</i>	0	0	0	0	0	0	1	0	0	0	1	0	0	0	1	0	1	0	1	0	0
<i>micrommatum</i>	0	0	0	0	0	0	1	0	0	0	1	0	0	0	1	0	1	0	1	0	0
<i>microsculptum</i>	0	0	0	0	?	0	1	0	0	0	1	1	0	0	1	0	0	0	0	0	0
<i>morisitai</i>	0	1	1	0	0	0	1	0	0	0	1	0	0	1	1	1	0	0	0	0	0
<i>numidicum</i>	1	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	1	0	0
<i>oceanicum</i>	1	0	0	0	0	1	0	0	0	0	0	0	0	1	1	0	0	0	2	1	0
<i>panamense</i>	0	0	0&1	0	0	0	1	0	0	0	1	0	0	0	1	0	1	0	1	0	0
<i>papuanum</i>	1	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	2	1	0
<i>pergandei</i>	0	1	1	0	?	0	1	0	0	1	1	0	0	0&1	1	1	0	0	0	0	1
† <i>poinari</i>	0	0	0	0	0	0	1	0	0	0	?	0	0	0	1	0	0	0	1	0	0
<i>politum</i>	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	1	0
<i>pumilio</i>	1	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	1	0	0
<i>relictum</i>	1	0	0	0	0	1	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0
<i>robustum</i>	1	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	1	0	0
<i>siamense</i>	1	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	2	1	0
<i>silaceum</i>	1	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0&1	0	0
<i>snellingi</i>	1	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	2	2	0
<i>stictum</i>	0	0	0	1	0&1	0	1	0	0	0	1	0	0	0	1	1	0	0	0	0	0
<i>striativenter</i>	1	0	0	0	0	0	0	1	0	0	0	0	0	1	1	1	0	0	2	2	0
<i>sulawense</i>	1	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	2	1	0
<i>taino</i>	0	0	0	0	0	0	1	0	0	0	1	0	0	0	1	0	1	0	0	0	0
<i>terraealtae</i>	1	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	2	1	0
<i>terroni</i>	0	1	1	0	0	0	1	0	0	0	1	0	0	0	1	0	0	0	0	0	0
<i>tio</i>	0	0	0	1	0	0	1	0	0	0	1	0	0	0	1	1	0	0	0	0	0
<i>toschii</i>	0	1	1	0	0	0	1	0	0	0	1	0	0	0	1	0	0	0	0	0	?
<i>transitionis</i>	0	0	0	0	0	0	1	0	0	0	1	0	0	0	1	0	0	0	1	0	0
<i>watasei</i>	0	1	1	0	?	0	1	0	0	0	1	0	0	1	1	1	0	1	0	0	1
† <i>Discothyrea gigas</i>	0	0	0	0	0	0	0	0	1	0	0	0	0	?	0	0	1	0	0	0	0
<i>Discothyrea sculptor</i>	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
<i>Discothyrea stumperi</i>	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0
† <i>Bradoponera sp.</i>	?	1	0	0	0	0	0	0	0	0	?	0	0	1	?	0	0	0	0	0	0
† <i>Bradoponera meieri</i>	?	1	0	0	0	0	0	0	0	0	?	0	0	1	?	0	0	0	0	0	0



## DIAGNOSIS and DESCRIPTION

Worker. Monomorphic but variable in size. Head subglobose, generally longer than broad, rarely as long as broad or broader than long, variable in shape, i. e. with sides convex, subparallel, diverging posteriorly or converging anteriorly. Median part of the clypeus either unarmed (truncate), or armed with an anterior projection varying from small to developed, convex, rectangular or triangular in shape. Frontal carinae generally apart from each other, rarely attached and never or only partially covering the antennal insertions. Lateral expansions of the frontal carinae broad or narrow, diverging backwards, rarely touching each other posteriorly, gently convex or straight. Genal carina absent or present but variably marked and generally delimiting a variably impressed sulcus. Gular area impressed or not. Eyes absent or present, but, if present, always reduced to small pigmented spots or a clear convex facet, and placed approximately around the mid line of the head. Ocelli absent, rarely the workers of a few species may have only the anterior ocellus vestigial or as developed as in the gyne. Antennae 12-jointed. Scapes surpassing, reaching or much shorter than the vertexal margin and always thickening apically. First funicular joint about as long as broad or slightly broader than long or longer than broad. Funicular joints 2-10 broader than long, or about as broad as long, or slightly longer than broad. Last funicular joint as long as the sum of joints 6-10, or 7-10 or 8-10. Mandibles subtriangular. Basal margin of the mandibles straight or convex distally. Masticatory margin of the mandibles with 2-13 denticles of variable size followed by a pointed apical tooth. Palp formula (counting the protuberance fused with the stipes as the basalmost segment as already done by Brown, 1980 and Onoyama & Yoshimura, 2002) 2,2, 3,2, 3,3, or 4,3. Second maxillary palp joint hammer-shaped.

Mesosoma short to elongate. Dorsum of the mesosoma sloping posteriorly or variably convex dorsally. Promesonotal and metanotal sutures absent, obsolete or rarely impressed. Promesopleural and meso-metapleural sutures more impressed ventrally. Propodeum unarmed, simply angulate or denticulate or toothed, rarely with a pair of spines. Area between basal and declivous faces of the propodeum variably concave medially and with or without carina. Each side of the declivous face of the propodeum with a lamella or a variably marked carina. Propodeal lobes simply convex or truncate, with or without a pointed or rounded dorsal tooth. Propodeal spiracle

round or tubuliform and placed at mid height in lateral view. Petiole variable in size, width and height. Petiolar node in shape of an erect scale of variable width and thickness, or leaf-shaped. Ventral petiolar process small or large, truncate, triangular or spiniform. Postpetiole (abdominal segment III) anteriorly as broad as or broader than petiole. Postpetiole in dorsal view anterolaterally with diverging, convex or angulate sides. Postpetiolar sternite anteromedially with a variably marked subtriangular projection bearing or not a longitudinal carina prolonged posteriorly. Constriction between postpetiole and gastral segment I variably impressed. Gastral tergum I of variable length, variably convex, continuously curved dorsoventrally or with the posterior half clearly separated by a curve from the dorsal part. Sides of the gastral sternite I strongly or slightly projecting anteriorly. Remaining gastral tergites and sternites curved ventrally. Sting developed, curved downwards. Legs short or variably elongate. Tibiae of fore and hind legs with a large, pectinate spur. Mid tibiae with or without a pectinate spur variably developed. Spurs of fore legs with or without a basal spine. Mid basitarsi shorter or at most as long as the fore ones. Second tarsomere of the three pairs of legs slightly or much longer than each third and fourth tarsomeres. Pretarsal claws simple. Arolia of variable size. Head, mesosoma, petiole, postpetiole and gastral tergum I variably reticulate and/or granulo-punctate; this sculpture superimposed or not by irregular rugosities or by foveae. Remaining gastral tergites variably smooth, reticulate-punctate, punctate, or punctate-foveolate. Legs variably smooth, with superficial or deep punctation-granulation. Body with at least three main types of hairs: (1) short and generally dense, suberect or subdecumbent on the whole body, (2) long erect or suberect on the whole body, sometimes subdecumbent, dense or sparse, rarely absent and (3) very short, decumbent or appressed on the funicular joints only. Colour yellowish light brown, reddish-brown, dark brown or black. Legs concolourous with or lighter than the body.

Gyne. Similar to the worker but slightly differing from it, even in the usual caste-dependant characters. The most salient of these characters are the following: size generally larger; compound eyes larger and with ocular pilosity; ocelli always present; mesosoma always robust; promesonotal and propodeal sutures impressed; metanotum sometimes spiniform. Basal face of the propodeum very short or slightly prolonged backwards.



Wings. Fore wings variably pigmented, in some species infusate, brown or whitish-yellow hyaline. The wing venation appears to follow five distinct patterns as follows:

1. *m-cu* marked and *Rsf3* not reaching *Rsf1*. *2r*, *Rsf4*, *Rsf5*, *r-m*, *Mf4* marked. *Rsf5* reaching the Costa (Fig. 94).

2. *m-cu* marked, *Rsf3* and *Rsf4* absent. *2r*, *Rsf5*, *r-m*, marked. *Rsf5* not reaching the Costa (Fig. 50).

3. *m-cu* marked, *Rsf3*, *Rsf4*, *r-m* and *Mf4* absent. *2r*, *Rsf5* marked. *Rsf5* not reaching the Costa (Fig. 46).

4. *m-cu*, *Rsf3* and *Rsf4* absent. *2r* very long, *Rsf5*, *r-m*, and *Mf4* of variable length. *Rsf5* not reaching the Costa (Fig. 66).

5. *m-cu*, *Rsf3*, *Rsf4*, *r-m* and *Mf4* absent. *2r* very long, *Rsf5* of variable length. *Rsf5* not reaching the Costa (Fig. 79).

Hind wings pigmented as the fore wings and showing three venation patterns:

1. *r-m* distinct and *R* reaching the anterior margin. *M* and *CuA* variably marked (Fig. 94).

2. *r-m* distinct and *R* not reaching the anterior margin. *M* and *CuA* variably marked (Fig. 69).

3. *r-m* absent. *M* and *CuA* variably marked (Fig. 64).

Male. Size variable, generally smaller or nearly as large as the gyne. Head about as broad as long, broader than long or longer than broad. Vertex variably convex. Clypeus anteromedially variably projecting; it can be simply straight, slightly convex, subrectangular or subtriangular. Frontal carinae reduced, never hiding the antennal socket and generally separated each other, rarely close each other. Sides of the frontal carinae subparallel, or slightly diverging posteriorly. Antennae 13-segmented. Ocelli large. Compound eyes very large and mostly on the anterior half of the head sides. Scapes variable in size, not reaching or surpassing the anterior ocellus or slightly surpassing the vertexal margin. First funicular joint shorter than or as long as the second; distal joint as long as the sum of joints 10-11 or 9-11. Mandibles slender, edentate or minutely and irregularly denticulate, and with a visible apical, pointed tooth. Palp formula (stipes protuberance included) 3,2, 4,3, 5,2 or 5,3. Second maxillary palp joint hammer-shaped. Mesosoma robust. Mesonotum and scutellum convex. Propodeum with or without differentiate basal and declivous faces. Sides between basal and de-

clivous faces of the propodeum separated by similar projections as in the worker and gyne but much more reduced. Metanotum spiniform or not. Propodeal lobes similar to those of the worker and gyne. Petiole variably convex, rarely scale-like, lower and narrower than in the worker and gyne. Subpetiolar process and postpetiolar sternite with structures resembling those of the worker and gyne but usually much more reduced. Postpetiole broader than the petiole. Gastral segments generally less curved than in the worker and gyne. Legs long and slender. Sculpture similar to the one of the worker and gyne but generally more superficial; few species with the sculpture on the first gastral tergite more impressed than in the worker and gyne. Pilosity resembling the one of the worker and gyne but slightly less dense.

Wings. Gynes and males have similar fore and hind wings. Male wings are usually smaller than those of the gynes but their venation follows the same patterns.

Colour generally darker than the worker and the gyne. Some species black with lighter legs.

The larvae of *Proceratium crassicorne* and *croceum* were described by Wheeler & Wheeler (1952). According to the same authors (Wheeler & Wheeler, 1976) the *Proceratium* larvae differ from those of *Discothyrea* by having the integument beset with large hemispherical bosses instead of with only one pair of bosses or without bosses.

Notice that these differences are drawn from the study of three *Proceratium* and one *Discothyrea* species.

Kugler (1991) described the sting of a number of "Ectatommini" sensu Brown (1958a), i. e. including the Proceratiini. This study is based on dissections of specimens representing 21 different species among which one *Proceratium* and one *Discothyrea*. The paper suggests a set of eight synapomorphies for these two genera but no apomorphies for *Proceratium*.

Lattke (1994), after a cladistic analysis of 14 ponerine genera and two non-ponerine outgroups based on 36 characters, gives a list of eight "attributes" of *Proceratium*. We entirely support this approach to the study of ponerine phylogeny and classification but we encountered a number of problems in interpreting Lattke's conclusions.

First, we re-analysed Lattke's data by means of PAUP 4.0b2a and we regularly obtained results different from those of Lattke by using various conjectures about character evolution and character polymorphism. We suppose that the difference should be explained by a number of assumptions

formulated by Lattke (l. c.) and not described in his paper. In the legend of his Table 1 it is stated that “characters 1, 7, 9, 15, 33 & 35 were treated as unordered”. We would have treated all characters as unordered but we were unable to find in Lattke’s text how the remaining characters were treated in his analysis.

To overcome this difficulty we reconstructed Lattke’s consensus tree (his Fig. 8) by hand.

In this tree *Proceratium* is characterised by only one apomorphy: the edge of the posterior petiolar foramen straight (as opposed to invaginated in other ponerines). Notice that this character is apparently unique to *Proceratium* but its uniqueness is drawn from the dissection of three *Proceratium* and two *Discothyrea* specimens.

Another apparently plausible assumption by Lattke (l. c.) is worth discussion here. In case of variation for a meristic character (like the number of palp joints) only the highest count was recorded. This assumption is in agreement with the common (and plausible) hypothesis that the ancestral formicid should have had the highest known palp formula (i. e. 6,4). In Lattke’s phylogeny considering the evolution of the number of maxillary palps as unordered needs only 7 evolutionary steps for a 6 steps character and the ponerine ancestor is reconstructed as having six-jointed palps (in agreement with the initial hypothesis) or four (in contrast with the initial hypothesis). *Acanthoponera*, *Amblyopone* and *Rhytidoponera* should have increased their number of palp joints after a series of ancestors with 4 palpomeres. In the same phylogeny, assuming the evolution of the number of maxillary palps to be ordered needs 12 evolutionary steps and assuming it to be irreversible, 20 steps. All these hypotheses, however, overlook a number of supra- and infra-generic losses and secondary gains that are known to have occurred within the Ponerinae. Just to make an example, in *Proceratium* the number of maxillary palps can be 4, 3, or 2 and, in *Discothyrea*, 5, 4, and 1. Due to this degree of polymorphism their immediate ancestral state cannot be reconstructed with certainty but it is legitimate to suppose that it needs not to represent the highest count.

According to our observations the genus *Proceratium* appears to be characterised by at least the following three synapomorphies:

1. Worker eyes either absent or composed by minute, reduced, flat ommatidia or by a single convex facet (ommatidia salient in *Discothyrea* and in *Bradoponera*).

2. Worker and gyne with a short last funicular joint (much longer in both *Discothyrea* and *Bradoponera*).

3. Worker and gyne with dentate mandibles (edentate in both *Discothyrea* and *Bradoponera*).

The hammer-shaped second joint of the maxillary palps of both female castes and males *Proceratium* appears to be unique among ants. This character (Fig. 44) was first described by Kennedy and Talbot (1939), pointed out as typical for *Proceratium* by Brown (1958a) and stressed again by Onoyama and Yoshimura (2002). Its condition in *Discothyrea*, however, is not linear, as it can be surmised from a figure of the palps of *D. sexarticulata* by Borgmeier (1954). We dissected specimens of *D. stumperi* and of an unidentified *Discothyrea* species from Manazuru, Kanagawa Pref., Japan. The second joint appears to be variably curved in these species, though never hammer-shaped as in *Proceratium*. Unfortunately, the synapomorphic state for *Proceratium* could be confirmed only by presence of the plesiomorphic state in both its most closely related genera: *Discothyrea* and *Bradoponera*. All *Bradoponera* specimens we studied appear to share a slender second joint of the maxillary palps. In all these specimens the palps are well visible in profile only and recognition of the hammer-shaped structure in ventral view appears unlikely but can not be categorically excluded. Mayr (1868) also observed the maxillary palps of *B. meieri* without mentioning the presence of the hammer-shaped structure. We suppose that absence of this structure in *Bradoponera* is highly probable, although not completely demonstrated. The morphology of the second maxillary palp joint should be also regarded as a very conceivable synapomorphy for *Proceratium*.

Lattke (1994) suggests an additional plausible generic synapomorphy for *Proceratium*: the presence of integument invaginations in the posterior foramen of the petiole. We did not explicitly consider this character since we are unable to see it properly in a number of critical taxa, including all the *Bradoponera* species.

## THE INTERNAL PHYLOGENY OF *PROCERATIUM*

Search for the most parsimonious tree(s) was performed by PAUP 4.0b2a as described in the Methods chapter. Given the great number of taxa included in our analysis (77 *Proceratium* plus 5 outgroup species) we were forced to use a set of heuristic search algorithms. The maximum number of trees to be retained after completing each search was always set to 10,000.

The search procedures we used and their results are listed in the following:

1. Addition of taxa simple, branch swapping by tree bisection-reconnection: 10,000 trees of length 286.
2. Addition of taxa simple, branch swapping by subtree pruning-regrafting: 10,000 trees of length 286. 394 trees equal to those already found during search # 1. A total of 19,606 trees retained.
3. Addition of taxa simple, branch swapping by nearest-neighbour interchange: 10,000 trees of length 298. Discarded.
4. Addition of taxa closest, branch swapping by tree bisection-reconnection: 10,000 trees of length 286. 165 trees equal to those already found during search # 1 and 2. A total of 29,441 trees retained.
5. Addition of taxa closest, branch swapping by subtree pruning-regrafting: 10,000 trees of length 286. 344 trees equal to those already found during searches # 1, 2 and 4. A total of 39,097 trees retained.
6. Addition of taxa closest, branch swapping by nearest-neighbour interchange: 10,000 trees of length 294. Discarded.
7. Addition of taxa random (20 replicates with no more than 500 trees per replicate retained), branch swapping by tree bisection-reconnection: 10,000 trees of length 286. 114 trees equal to those already found during searches # 1, 2, 4 and 5. A total of 48,983 trees retained.
8. Addition of taxa random (20 replicates with no more than 500 trees per replicate retained), branch swapping by subtree pruning-regrafting: 8,000 trees of length 286. 181 trees equal to those already found during searches # 1, 2, 4, 5, and 7. A total of 56,802 trees retained.
9. Addition of taxa random (20 replicates with no more than 500 trees per replicate retained), branch swapping by nearest-neighbour interchange: 500 trees of length 286. 11 trees equal to those already found during searches # 1, 2, 4, 5, 7, and 8. A total of 57,291 trees retained.

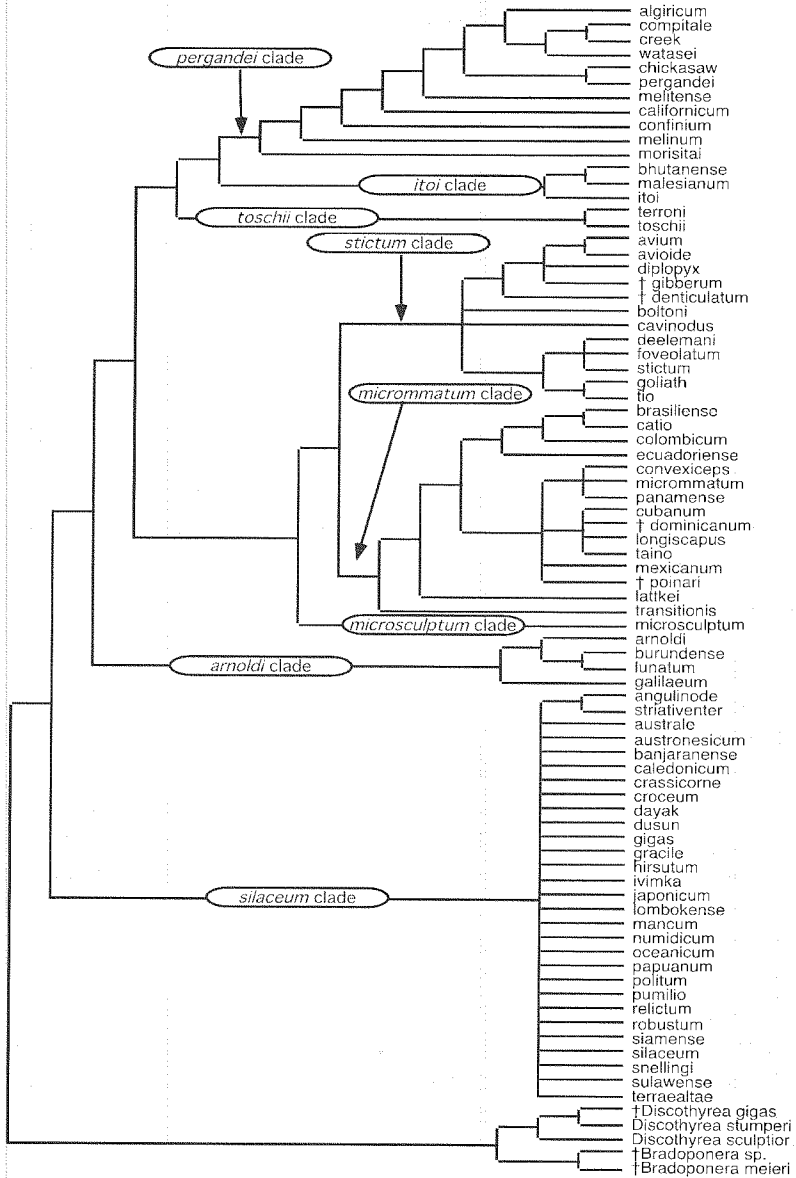


Fig. 29 – Strict consensus tree for the *Proceratium* species and for the outgroups considered in our analysis resulting from the 57,291 optimal trees found by means of the heuristic searches described in the text.

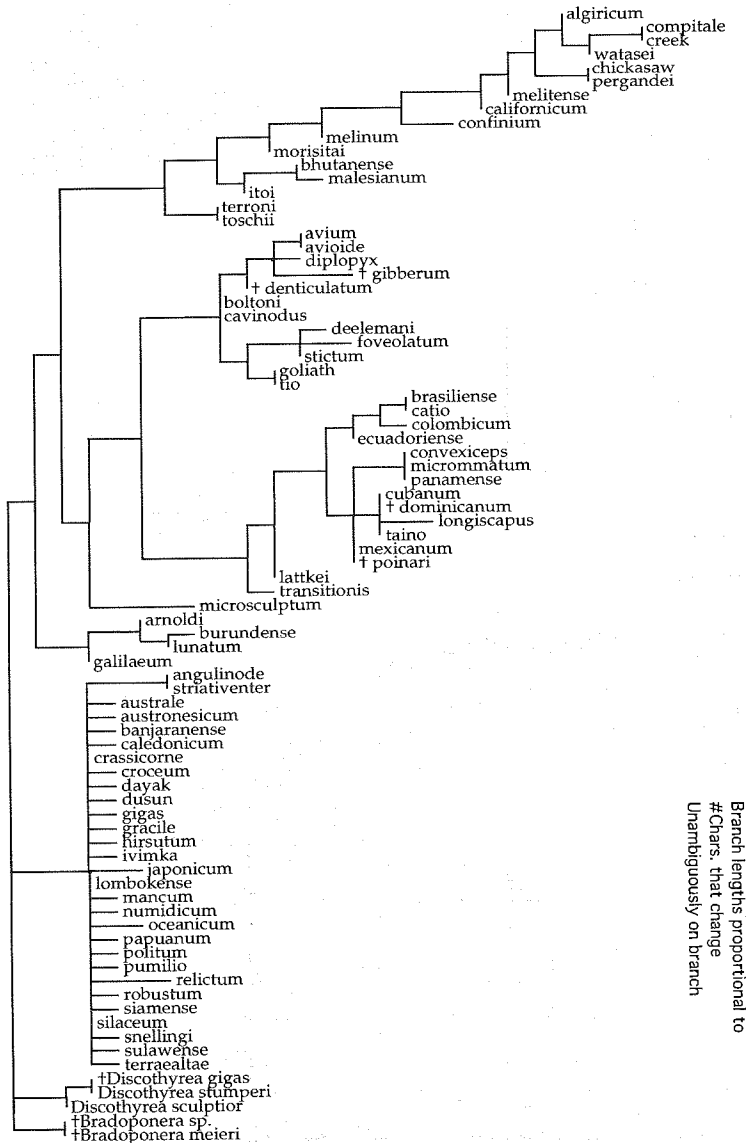


Fig. 30 – Same tree as the one of figure 29 expressed as a phylogram, i. e. with the lengths of the branches proportional to the number of apomorphies supporting them.

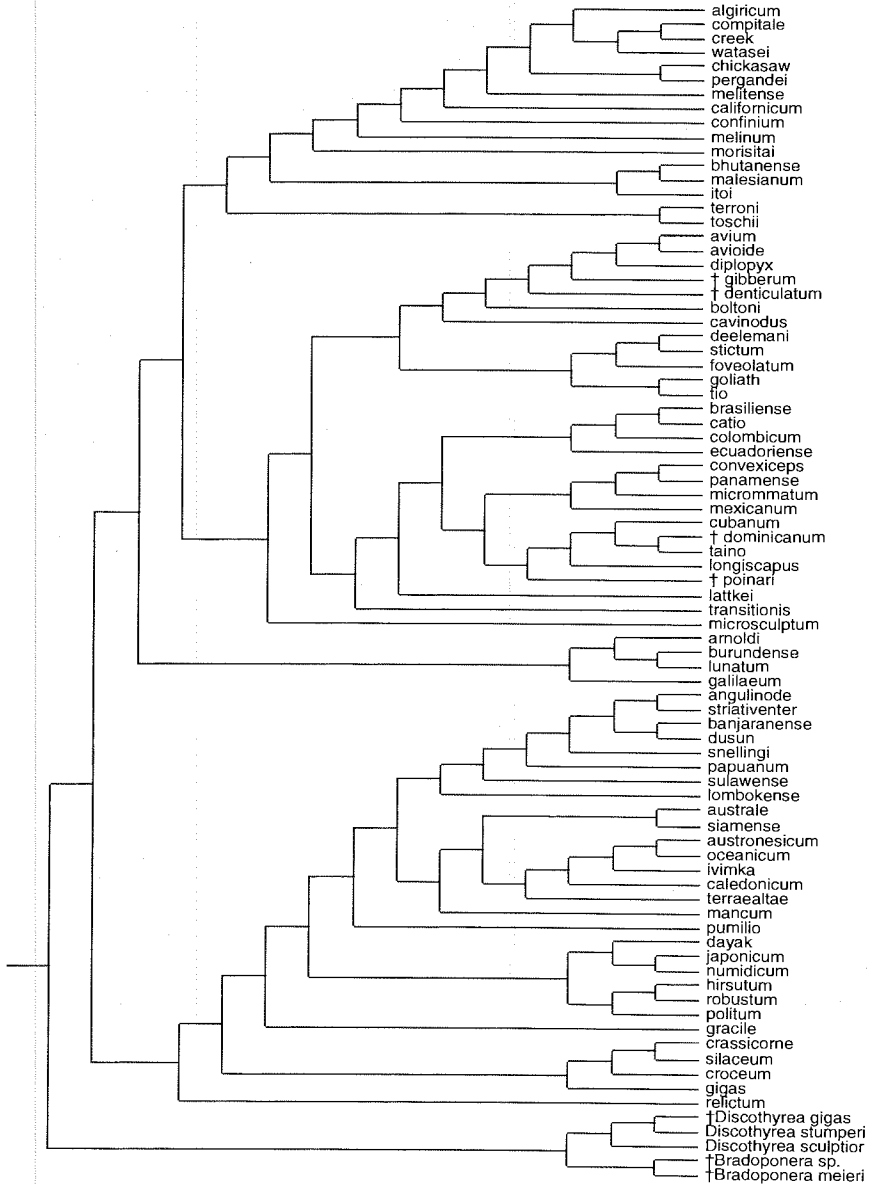


Fig. 31 – Arbitrarily selected optimal tree to be used as a tool to test some evolutionary hypotheses.



We consider hence that it is very unlikely that there are trees shorter than 286 (CI = 0.678; RI = 0.913; RC = 0.619; HI = 0.503). Giving to all characters equal weight (i. e. 1), the length of our trees drops to 157 with CI = 0.682, RI = 0.915, RC = 0.623, HI = 0.503.

The strict consensus tree drawn from the 57,291 different optimal trees found during our searches is given in Fig. 29.

Our analysis permits the recognition of eight homogeneous clades termed in Fig. 29 after the name of a representative species. These clades will be listed and defined in the following chapter.

Fig. 30 contains information similar to the one of Fig. 29 but portrayed in form of phylogram where the branches are of length proportional to the number of evolutionary steps recognised.

There are, however,  $10^{92.467587}$  trees potentially satisfying the requirements of our consensus tree. We feel unable to decide, as it is often done in other papers, which one of these  $10^{92.467587}$  trees is the one that we prefer. And we suspect that few readers might be interested in our preferences. Nonetheless, to attempt the reconstruction of the evolution of a few characters (see later, the Concluding Remarks), we were in need of a completely resolved *Proceratium* phylogeny. This arbitrary completely resolved phylogeny, selected among the optimal ones for purely practical reasons, is given in Fig. 31.

## THE *PROCERATIUM* CLADES AND THEIR SPECIES

### THE *STICTUM* CLADE

This clade corresponds to the former *stictum* group of Brown (1958a, 1974) originally comprising four species only: *stictum*, *goliath*, *avium* and *boltoni*. Another four species were added by subsequent publications: *diplopyx*, *deelemani*, *denticulatum*, and *tio*. In this paper we describe another four species belonging to the same clade: *avioide*, *gibberum*, *foveolatum* and *cavinodus*. The *stictum* clade, in our study, comprises the following 12 species: *avium*, *avioide*, *boltoni*, *gibberum*, *deelemani*, *denticulatum*, *diplopyx*, *foveolatum*, *goliath*, *stictum*, *cavinodus*, *tio*.

The members of the *stictum* clade share the following worker, gyne and male synapomorphy: the presence of a basal spine on the protibial spur (Fig. 38). This character results synapomorphic for the *stictum* clade in our analysis but it is also present in all the members of the phylogenetically distant *pergandei* clade. Latke (1990) already described this character under the name of 'seta of the protibial spur' for the fossil species *denticulatum*.

Five species within the *stictum* clade appear in a distinct group named here as *goliath* group: *deelemani*, *foveolatum*, *goliath*, *stictum* and *tio*. These species share the following synapomorphy: worker and gyne with gular area deeply concave (char. 24). They also share large, deep, irregular foveae and granulation on the head, mesosoma, petiole and postpetiole and dense, long hairs. We did not use these characters for the cladistic analysis because the sculpture is less impressed in *stictum*, the basal species of the *goliath* group and similar sculptures can be found also among members of other clades like the *micrommatum* and *arnoldi* clades. In an analogous way, a pubescence similar to that of the *goliath* group can be encountered in members of the *micrommatum* and *silaceum* clades.

Five of the remaining 7 species of the *stictum* clade constitute a group of species named here as *avium* group. This group comprises the following species: *avium*, *avioide*, *gibberum*, *denticulatum* and *diplopyx*. These five species share synapomorphically the antennal joints 2-10 at least as broad as long. This trait is also shared by other species of a far clade.

Two species, *boltoni* and *cavinodus* appear in an unresolved position within the clade. *P. boltoni* and *cavinodus* in general morphology resemble the fossil members of the *avium* group: *gibberum* and *denticulatum*. This similarity is supported by the following characters: integument reticulate-foveolate and granulate, subpetiolar process spiniform, and with the fossil *denticulatum* only, frontal carinae low and subparallel and clypeal notch laterally denticulate.

The 12 species of the *stictum* clade appear to be irregularly distributed in the tropics of the world. *Goliath* and *tio* are known respectively from Mexico and Costa Rica, *gibberum* and *denticulatum* from Dominican amber, *foveolatum* from Malaysia, *boltoni* from Ghana, *cavinodus* and *stictum* from Australia, *avium* and *avioides* from Mauritius, *diplopyx* from Madagascar, and *deelemani* from Thailand and Malaysia.

Brown (1958a, 1974) considers the shape of the clypeus, of the mandibles and of the petiole of the species of this clade as 'primitive'

within the genus *Proceratium*. This assumption is probably based on the fact that a nodiform petiole is likely to better represent the ponerine ancestral condition than the squamiform petiole "type *Sysphincta*". Unfortunately there is no morphological evidence for this since the two genera closer to *Proceratium* have a petiole either scale-like (*Bradoponera*) or scale-like to weakly nodiform (*Discothyrea*). We are unable to define two or more clear-cut mandibular morphologies to be used as discrete characters for phylogenetic purpose within *Proceratium*. According to the character evolution compatible with our phylogenetic reconstruction, however, the plesiomorphic clypeal morphology for *Proceratium* should be either convex and protruding (like in *Discothyrea* and *Bradoponera*), or straight (like in the basal *silaceum* clade). The members of the *stictum* clade, with their notched clypeus, appear to exhibit the derived and not the plesiomorphic clypeal morphology.

### ***Proceratium boltoni* Leston**

Fig. 32

*Proceratium boltoni* Leston, 1971: 118, figs. 1 & 2 (worker). Worker and gyne. Original description. Type locality: Legon, Ghana. Type material: Holotype worker deposited in MCZC, not seen. 8 paratype workers labelled: "Legon, A. D., Ghana, 8.VII.1970, D. Leston, in piece of rotten twig, 2" below ground, Paratype, *Proceratium boltoni* Leston" or variations thereof, in LACM, MCZC, MHNG, MRSN, MZSP, NHMB; all examined.

DIAGNOSIS. A member of the *stictum* clade, appearing in an unresolved position within the species of this clade and differing from all the other species, in the worker, by the following combination of characters: funicular joints 2-10 broader than long, frontal carinae low, narrow and subparallel and ventral process of the petiole needle-shaped.

DESCRIPTION. *Worker* (Fig. 32). Head longer than broad, with subparallel sides. Vertex convex in full face view and flat in posterior view. Clypeus broad, subconvex, protruding anteriorly and surrounding the whole antennal insertion. Anteromedian margin of the clypeus with a superficial notch denticulate on each side; each denticle with a short, dorsal, convergent carina. Frontal carinae separate from each other, subparallel and not covering

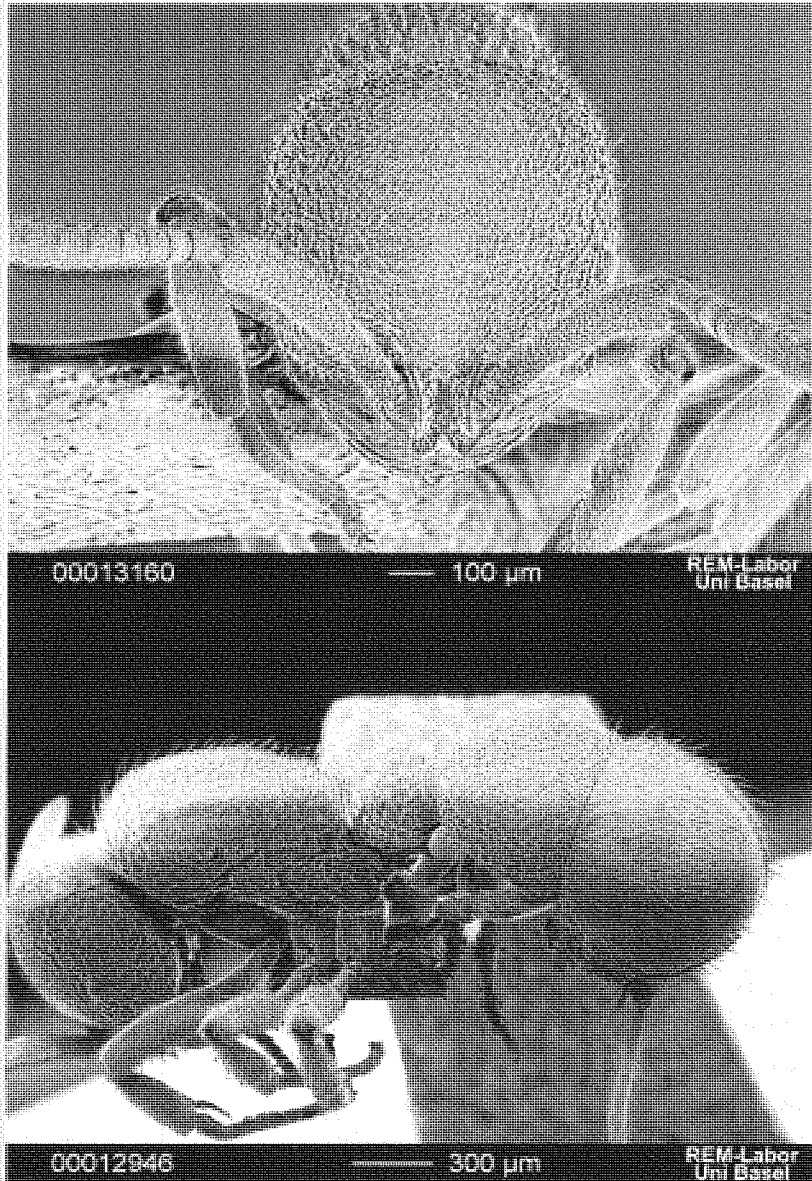


Fig. 32 – *Proceratium boltoni* Leston. Worker (paratype) from Legon, Ghana: head (top) in dorsal view and meso- and metasoma (bottom) in oblique side view.

the antennal insertions, their expansions narrow and low. Frons gently concave medially. Genal carina present and more marked posteriorly. Gular area gently impressed. Eyes present, with a single convex ommatidium below the head midline. First funicular joint about as long as broad. Funicular joints 2-10 broader than long. Last funicular joint about as long as the sum of joints 7-10. Scapes not attaining the vertexal margin and gently thickening apically. Masticatory margin of the mandibles with 2-3 denticles before the pointed apical tooth. Palp formula 4,3.

Mesosoma slightly longer than head length (mandibles included), gently convex in profile. Promesonotal and propodeal sutures absent. Promesopleural and mesometapleural sutures visible and more impressed ventrally. Propodeal sides angulate or denticulate between basal and declivous faces. Propodeal lobes with a small, subround dorsal tooth. Propodeal spiracle round and above mid height in lateral view.

Petiole slightly broader than long. Its sides diverging on the anterior third and convex on the two posterior thirds in dorsal view. Anterior border of the petiole concave and transversally carinate, the carina denticulate on each side. Ventral process of the petiole spiniform, rarely bispinose. Postpetiole broader than petiole and with diverging sides. Postpetiolar sternite anteromedially with a variably marked subtriangular projection. Posterior half of the postpetiolar sternite strongly convex. Constriction between postpetiole and gaster deep. Gastral tergite I strongly convex. Gastral sternite I not projecting anteriorly. Remaining gastral tergites and sternites curved ventrally.

Legs slender, not very elongate. All tibiae with a pectinate spur. Spurs of fore legs with a basal spine. Fore basitarsi slightly longer than the mid ones. Hind basitarsi about 0.8 of the length of the hind tibiae. Second tarsomere of mid and hind legs longer than third and fourth tarsomeres and about as long as the pretarsus. Pretarsal claws simple. Arolium small.

Sculpture. Head irregularly reticulate-punctate, the reticulation larger, deeper and approaching foveae on the vertex and sides of the head. Mesosoma, petiole and postpetiole irregularly foveolate-granulate, the granulation in some parts raised as peaks. First gastral tergite smooth, with dense, minute piligerous foveae, the foveae denser and slightly larger on the sides. Legs and scapes with dense punctures.

Body covered by hairs of three main types: (1) short, dense, suberect or subdecumbent on the whole body, erect and sparse on the funicular joints; (2) long, suberect or subdecumbent, sparse on the whole body except the scapes and the funicular joints; (3) shorter than type (1), dense and decumbent on the funicular joints only. In addition, the funicular joints bear thick, appressed, short, sparse hairs and the scapes sparse hairs shorter than those of type (2).

Colour dark brown to black; anterior part of the head dorsum, scapes, mandibles and legs lighter.

Measurements in mm and Indices: TL 3.69-3.78; HL 0.85; HW 0.79-0.80; EL 0.07; SL 0.60; WL 1.08; PeL 0.36-0.38; PeW 0.38-0.42; HFeL 0.65-0.67; HTiL 0.55; HBaL 0.45; LS4 0.16-0.18; LT4 0.66-0.73; CI 92.9-94.1; SI 70.6; IGR 0.24-0.25.

*Gyne*. Briefly described by Leston (1971) from a single paratype specimen (collection of deposition not stated). No specimens of this caste were available for the present study.

MATERIAL EXAMINED: GHANA: ACCRA DISTRICT: Legon, 8.VII.1970, 8 workers (paratypes), in piece of rotten wood, D. Leston [LACM, MCZC, MHNG, MRSN, MZSP, NHMB]; same locality, 16.X.1970, 4 workers, D. Leston [LACM, NHMB].

DISCUSSION. *P. boltoni* is in an unresolved position within the *stictum* clade. In general shape and sculpture, *boltoni* resembles *cavinodus* and two Dominican fossil species, *denticulatum* and *gibberum*. Both fossils, however, are known from the gyne only. *Boltoni*, *denticulatum* and *gibberum* share the ventral process of the petiole needle-shaped, a character not considered in our data matrix because it re-appears in an unpredictable way among other species of the genus. *Boltoni* also shares with *denticulatum* the low, subparallel frontal carinae and both species share with *cavinodus* the clypeal notch laterally denticulate. The workers of *boltoni* (TL ~3.6-3.8 mm) and the sole known specimen of *cavinodus* (TL 3.3 mm) are the smallest species of this clade. We studied only a "dwarf" worker of *stictum* (TL 3.5 mm) ranging between *boltoni* and *cavinodus* in size.

According to Leston (1971) the type colony of *boltoni* comprised a dealate gyne, 34 mature workers, 8 callow workers, 3 worker pupae and 5 larvae.

DISTRIBUTION: Ghana.

**Proceratium cavinodus** de Andrade n. sp.

Fig. 33

TYPE MATERIAL: holotype worker (unique) labelled: "N.T. 5.vi.73, 11.59 S x 133.05 E, c. 5 km S of Tor Rock, outcrop area, R. W. Taylor, Acc. 73.434" in ANIC.

DERIVATIO NOMINIS: from the Latin *cavus* (= concave) and *nodus* (= node, i. e. a generic name for petiole and postpetiole), referred to the postpetiole morphology of the species.

DIAGNOSIS. A member of the *stictum* clade appearing in an unresolved position within it and differing from all the other species, in the worker, by the anterior face of the postpetiole anteromedially concave and weakly tumuliform laterally.

DESCRIPTION. *Worker* (Fig. 33). Head longer than broad, with subparallel sides. Vertex gently convex in full face view and flat in posterior view. Clypeus broad, subconvex, protruding anteriorly and surrounding the whole antennal insertions. Anteromedian margin of the clypeus with a superficial notch denticulate on each side; each denticle with a short, dorsal, convergent carina. Frontal carinae distant from each other, diverging posteriorly and not covering the antennal insertions. Lateral expansions of the frontal carinae very narrow and low. Genal carina present and more marked posteriorly. Frons medially concave. Gular area gently impressed. Eyes present, with only one convex facet, and placed below the mid line of the head. First funicular joint about as long as broad. Funicular joints 2-10 broader than long. Last funicular joint about as long as the sum of joints 7-10. Scapes not attaining the vertexal margin and gently thickening apically. Masticatory margin of the mandibles with 3-4 denticles before the pointed apical tooth. Palp formula 4,3.

Mesosoma as long as head length (mandibles included), gently convex in side view. Promesonotal and propodeal sutures absent. Promesopleural and mesometapleural sutures more impressed ventrally. Basal face of the propodeum gradually sloping posteriorly. Each side between the basal and declivous faces of the propodeum with a small pointed tooth. Propodeal lobes with a small, subpointed dorsal tooth. Propodeal spiracle round and above mid height in lateral view.

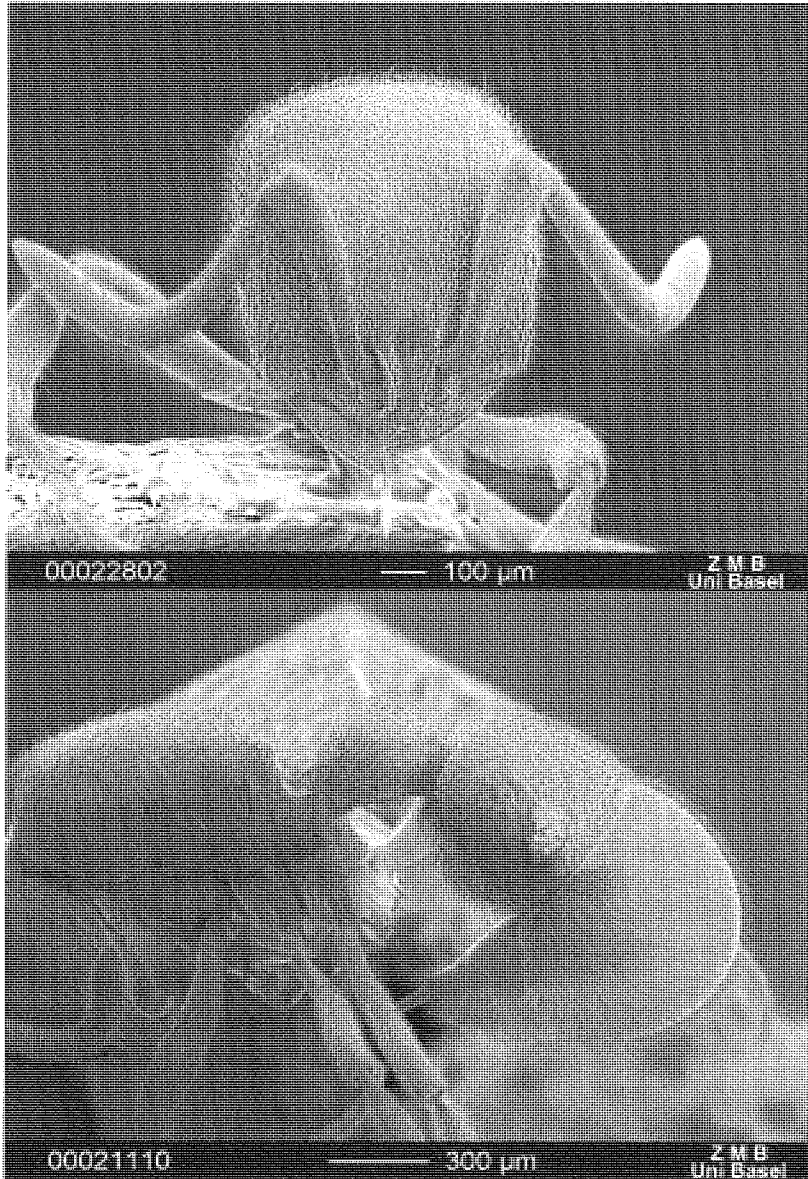


Fig. 33 – *Proceratium cavinodus* de Andrade. Worker (holotype) from Northern Territory, Australia: head (top) in dorsal view and meso- and metasoma (bottom) in oblique side view.



Petiole about as long as broad. Petiole in dorsal view with diverging sides on the anterior third and convex on the two posterior thirds. Anterior border of the petiole concave and carinate, the carina denticulate on each side. Ventral process of the petiole corresponding to a narrow, thin, longitudinal lamella. Postpetiole broader than petiole and with subparallel sides. Anterior face of the postpetiole medially concave and laterally slightly tumuliform. Postpetiolar sternite anteromedially with a variably marked subtriangular projection. Posterior half of the postpetiolar sternite strongly convex. Constriction between postpetiole and gaster deep. Gastral tergite I strongly convex. Gastral sternite I not projecting anteriorly. Remaining gastral tergites and sternites curved ventrally.

Legs slender, slightly elongate. All tibiae with a pectinate spur. Spurs of fore legs with a basal spine. Fore basitarsi longer than the mid ones. Hind basitarsi about 0.8 of the length of the hind tibiae. Second tarsomere of mid and hind legs longer than third and fourth tarsomeres and about as long as the pretarsus. Pretarsal claws simple. Arolium small but present.

Sculpture. Head irregularly reticulate-punctate. Mesosoma, petiole and postpetiole granulopunctate, in some parts the punctures resembling foveae and the granulation raised as peaks. First gastral tergite smooth and with dense piligerous punctures on the sides only. Legs punctate.

Body covered by hairs of three main types: (1) short, dense, suberect or subdecumbent on the whole body, erect and sparse on the funicular joints; (2) long, suberect or subdecumbent, sparse on the whole body but absent on the scapes and funicular joints; (3) shorter than hair type (1), dense and decumbent on the funicular joints only. In addition, the funicular joints bear thick, appressed, short, sparse hairs and the scapes sparse hairs shorter than hair type (2).

Colour light brown.

Measurements in mm and Indices: TL 3.29; HL 0.79; HW 0.68; EL 0.04; SL 0.54; WL 0.91; PeL 0.36; PeW 0.35; HFeL 0.62; HTiL 0.52; HBaL 0.45; LS4 0.12; LT4 0.63; CI 86.1; SI 68.3; IGR 0.19.

MATERIAL EXAMINED: AUSTRALIA: NORTHERN TERRITORY: 11.59 S x 133.05 E, c. 5 km S of Tor Rock, 5.VI.1973, outcrop area, 1 worker (holotype), R. W. Taylor [ANIC].

DISCUSSION. *P. cavinodus* is the smallest species of the *stictum* clade (TL = 3.29 mm instead of TL  $\geq$  3.5 mm for all the other species). In our phylogeny it appears in an unresolved position within the *stictum* clade. In general morphology and sculpture it resembles the Dominican fossils *denticulatum*, *gibberum* and the Recent *boltoni* from Ghana. *P. cavinodus* differs from these three species mainly by the shape of the postpetiole as already stated in the diagnosis.

DISTRIBUTION: Australia.

### † *Proceratium denticulatum* Latkke

Fig. 24

*Proceratium denticulatum* Latkke, 1990: 101, figs. 1 & 2, gyne. Gyne. Original description. Type locality: Dominican amber. Type material: one wingless gyne labelled: "Ambar Dominican, 20-23 x 10<sup>6</sup> años, Donacion: Sra. Mary Lou Gadou, Holotipo, *Proceratium denticulatum*, det. J. Latkke 1987", in MIZA, examined.

DIAGNOSIS. A *Proceratium* species belonging to the *avium* group where it occupies the basalmost position. It differs from the next in-group species, *gibberum* and *diplopyx*, by the gastral tergite I simply round, without broad tumulus or exaggerated expansion on the curvature, by the fore basitarsi longer than the mid basitarsi instead of as long as the mid ones, by the TL = 4.27 mm instead of 5.26 mm.

DESCRIPTION. *Gyne* (Fig. 24). Head longer than broad. Sides of the head subparallel anteriorly and weakly converging posteriorly. Vertex convex in full face view and flat in posterior view. Clypeus broad, convex, protruding anteriorly and surrounding the whole antennal insertions. Anteromedian margin of the clypeus with a superficial notch denticulate on each side; each denticle with a short, dorsal, convergent carina. Frontal carinae separate from each other, subparallel and not covering the antennal insertions. Lateral expansions of the frontal carinae narrow and low. Frons deeply concave medially. Genal carinae marked. Eyes large and below the midline of the head and with ocular pilosity. Ocelli developed. Scapes slightly surpass-

ing the vertexal margin. First funicular joint about 1/2 longer than broad. Funicular joints 2-10 slightly longer than broad. Last funicular joint slightly longer than the sum of joints 8-10. Mandibles with 4-5 denticles before the apical tooth. Palp formula not visible.

Mesosoma robust. Pronotum perpendicular to mesonotum. Mesonotum gently convex. Parapsidal furrows superficially impressed. Scutellum about as high as mesonotum, with the sides gently converging and round posteriorly. Metanotum with a pointed spine. Propodeum with distinct basal and declivous faces laterally separated by a pointed tooth. Basal face of the propodeum dorso-medially concave and declivous posteriorly. Posterior sides of the declivous face of the propodeum with a crenulate lamella ending in a subpointed tooth. Propodeal lobes truncate. Propodeal spiracle tumuliform and above mid height in lateral view.

Petiole slightly longer than broad, in dorsal view with the sides diverging on the anterior third and convex on the two posterior thirds. Anterior border of the petiole concave and carinate, the carina denticulate on each side. Ventral process of the petiole spiniform. Postpetiole about 1/4 shorter than gastral tergite I (LT4). Postpetiole in profile with a short tumulus close to the middle of the posterior border and in dorsal view with the sides gently diverging posteriorly. Postpetiolar sternite with a marked subtriangular projection anteromedially; posterior half of the postpetiolar sternite convex. Constriction between postpetiole and gastral segment I impressed. Gastral tergite I strongly convex on the curvature. Remaining gastral tergites and sternites retracted.

Legs slender and elongate. All tibiae with a pectinate spur. Spurs of fore legs with a basal spine. Fore basitarsi slightly longer than the mid ones. Hind basitarsi very long and about 0.8 of the length of the hind tibiae. Second tarsomere of mid and hind legs longer than third and fourth tarsomeres and about as long as the pretarsus. Pretarsal claws simple. Arolia small.

Sculpture. Head irregularly reticulate, minutely punctate; in addition to this diffuse sculpture the vertex and the sides of the head irregularly foveolate-granulate. Mesosoma, petiole and postpetiole irregularly foveolate-granulate. First gastral tergite superficially reticulate-punctate. Legs and scapes densely punctate.

Body covered by hairs of three main types: (1) short, dense, suberect on the whole body, subdecumbent or erect and very sparse on the funicular

joints; (2) long, suberect or subdecumbent on the whole body, sparse, slightly longer and denser on the petiole, but absent on the scapes and on the funicular joints; (3) shorter than hair type (1), dense and appressed on the funicular joints only. In addition, the funicular joints bear thick, appressed, short, sparse hairs and the scapes sparse hairs shorter than hair type (2).

Colour dark brown.

Measurements in mm and Indices: TL 4.27; HL 0.91; HW 0.82; EL 0.20; SL 0.72; WL 1.28; PeL 0.46; PeW 0.40; HFeL 1.00; HTiL 0.69; HBaL 0.60; LS4 0.20; LT4 0.82; CI 90.1; SI 79.1; IGR 0.24.

MATERIAL EXAMINED: DOMINICAN AMBER, 1 dealate gyne (holotype) [MIZA].

DISCUSSION. *P. denticulatum* results in our analysis as the basalmost species of the *avium* group. It shares with all other species of the group the funicular joints 2-9 longer than broad. In body shape and sculpture it resembles the Dominican fossil *gibberum* and two Recent species, *boltoni* and *cavinodus* from Ghana and Australia respectively. *Denticulatum* has the gastral tergite I superficially reticulate-punctate; a similar sculpture is also present in *gibberum* but in this species it is larger and deeper.

We obtained smaller values in the measurements of the holotype of *denticulatum* when compared with those of Lattke (1990) after re-polishing the amber sample.

DISTRIBUTION: Dominican amber.

### † *Proceratium gibberum* de Andrade n. sp.

Fig. 14

TYPE MATERIAL: holotype winged gyne in the amber sample MCZC-25 from Yanigua, a small agglomeration 3 km W of the mine El Valle, in MCZC.

DERIVATIO NOMINIS: from the Latin “*gibber*” (Plinius) = hump-backed, referring to the gastral morphology of this species.

DIAGNOSIS. A *Proceratium* species belonging to the *avium* group and differing from all the species of this group by the gastral tergite I with a broad tumulus on the curvature.

DESCRIPTION. *Gyne* (Fig. 14). Head longer than broad, with sides parallel anteriorly and weakly diverging posteriorly. Vertex slightly convex in full face view and flat in posterior view. Clypeus broad, convex, protruding anteriorly and surrounding the whole antennal insertions. Anteromedian margin of the clypeus, on each side, angulate and with a very superficial notch. Frontal carinae apart each other, diverging posteriorly and not covering the antennal insertions. Lateral expansions of the frontal carinae narrow and low. Frons concave medially. Genal carinae marked and ending at about level of eyes posteriorly. Gular area gently concave. Eyes large and slightly below the mid-line of the head and with ocular pilosity. Ocelli developed. Scapes reaching the vertexal border. First funicular joint about 1/3 longer than broad. Funicular joints 2-10 slightly longer than broad. Last funicular joint as long as the sum of joints 7-10. Mandibles with 4-5 denticles before the apical tooth. Palp formula apparently 4,3.

Mesosoma robust. Pronotum perpendicular to mesonotum. Mesonotum gently convex. Parapsidal furrows impressed. Scutellum as high as mesonotum and broadly round posteriorly. Metanotum with a pointed spine. Propodeum with distinct basal and declivous faces laterally separated by a pointed tooth. Basal face of the propodeum dorso-medially concave and declivous posteriorly. Each side of the declivous face of the propodeum with a posterior crenulate lamella ending in a subround tooth. Propodeal lobes truncate. Propodeal spiracle tumuliform and over mid height in lateral view.

Petiole slightly longer than broad, in dorsal view with the sides diverging on the anterior third and convex on the two posterior thirds. Anterior border of the petiole gently concave and carinate, the carina denticulate on each side. Ventral process of the petiole spiniform. Postpetiole about 0.2 shorter than gastral tergite I (LT4), in side view with a short tumulus close to the middle of the posterior border and in dorsal view with the sides gently diverging posteriorly. Postpetiolar sternite anteromedially with a marked subtriangular projection. Constriction between postpetiole and gastral segment I impressed. Gastral tergite I with a broad tumulus on the curvature. Remaining gastral tergites and sternites retracted.

Legs slender, slightly elongate. All tibiae with a pectinate spur. Spurs of fore legs with a basal spine. Fore basitarsi slightly shorter than the mid ones. Hind basitarsi very long and about 1/8 shorter than hind tibiae. Second tarsomere of mid and hind legs longer than third and fourth tarsomeres, and about as long as the pretarsus. Pretarsal claws simple. Arolia present.

Fore wings of our type 3, hind wings of our type 2 as defined in the description of the genus.

Sculpture. Head deeply irregularly reticulate, minutely punctate; in addition to these sculptures, the vertex and the sides of the head irregularly foveolate-granulate. Mesosoma, petiole and postpetiole irregularly foveolate-granulate. First gastral tergite densely reticulate-punctate. Legs and scapes densely punctate.

Body covered by hairs of three main types: (1) short, dense, suberect or subdecumbent on the whole body, very sparse on the funicular joints; (2) long, suberect or subdecumbent, relatively dense and sparse on the whole body but absent on the scapes and on the funicular joints; (3) shorter than hair type (1), dense and appressed on the funicular joints only. In addition, the funicular joints bear thick, appressed, short, sparse hairs and the scapes sparse hairs shorter than hair type (2).

Colour black.

Measurements in mm and Indices: TL 5.26; HL 1.12; HW 1.02; EL 0.22; SL 0.87; WL 1.54; PeL 0.56; PeW 0.52; HFeL 1.16; HTiL 0.87; HBaL 0.81; LS4 0.26; LT4 1.00; CI 91.1; SI 77.7; IGR 0.26.

MATERIAL EXAMINED: DOMINICAN AMBER, one winged gyne (holotype) MCZC-25 [MCZC].

DISCUSSION. The tumulus on the curvature of the gastral tergite I distinguishes *gibberum* from all members of the *avium* group but not from other members of the *stictum* clade. A similar tumulus is also present in *foveolatum*, a member of the *goliath* group, and also in other species of other clades. The gyne of *gibberum* can be distinguished from the worker of *foveolatum* mainly by the first gastral tergite reticulate-punctate instead foveolate-punctate. The presence of the gastral tumulus among an array of different species should have a simple adaptive explanation and appears to be homoplastic according to the phylogeny proposed in this paper.

DISTRIBUTION: Dominican amber.

## **Proceratium diplopyx** Brown

Figs. 34, 35

*Proceratium diplopyx* Brown, 1980: 337, figs. 1 & 2 (worker). Worker. Original description. Type locality: Baie d'Antongil, Madagascar. Type material: holotype and paratype workers labelled: "Iaraka, 1000 m, Baie d'Antongil, 26.XI.1969, Madagascar, Prov. Tamatave, J. -M. Betsch", in MNHN (holotype) and in MCZC (paratype), both examined.

**DIAGNOSIS.** A *Proceratium* species differing from all the species of the *stictum* clade by the gastral tergite I greatly hypertrophied posteriorly.

**DESCRIPTION.** *Worker* (Figs. 34 & 35). Head longer than broad with sides gently converging posteriorly. Vertex weakly convex in full face view and flat in dorsal view. Clypeus broad, convex, protruding anteriorly and surrounding the whole antennal insertions. Anteromedian margin of the clypeus with a very superficial notch. Frontal carinae apart each other, subparallel and not covering the antennal insertions. Lateral expansions of the frontal carinae narrow and low. Frons medially concave. Genal carina marked. Gular area gently impressed. Eyes present, with a single convex facet placed below the mid line of the head. First funicular joint longer than broad. Funicular joints 2-10 slightly longer than broad. Scapes reaching the vertexal margin and gently thickening apically. Masticatory margin of the mandibles with 3 denticles before the pointed apical tooth. Palp formula 4,3.

Mesosoma slightly longer than the head (mandibles included). Promesonotal and propodeal sutures absent. Promesopleural and mesometapleural sutures more impressed ventrally. Basal face of the propodeum convex. Each side of the propodeum between basal and declivous face with a pointed tooth. Propodeal lobes with a small, triangular dorsal tooth. Propodeal spiracle tumuliform.

Petiole 1/5 longer than broad. Petiole in dorsal view with the sides diverging on the anterior third and convex on the two posterior thirds. Anterior border of the petiole concave and carinate, the carina denticulate on each side. Ventral process of the petiole small and obtuse. Postpetiole about half of the length of the gastral tergite I. Postpetiolar dorsum with a broad tumulus on the middle of the posterior half. Postpetiolar sternite anteromedially with a marked subtriangular projection followed by a short longitudinal superficial carina prolonging backwards. Posterior half of the postpetiolar

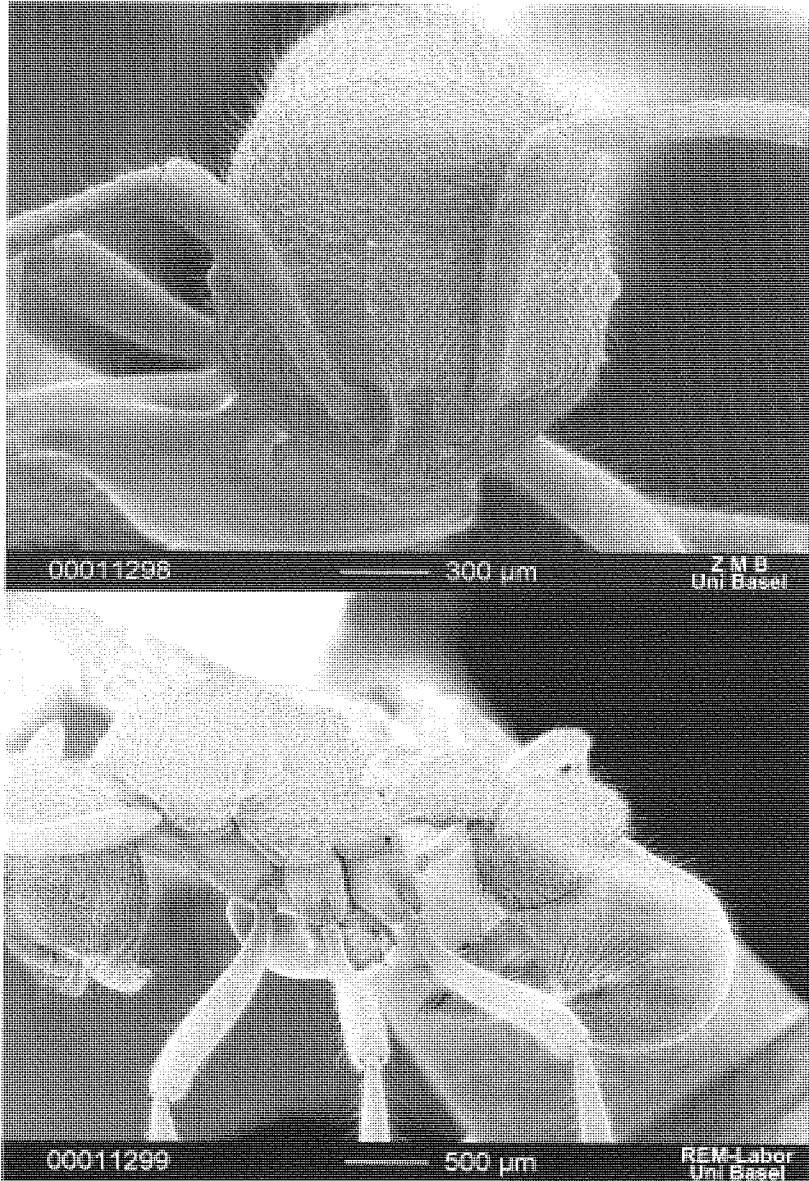


Fig. 34 – *Proceratium diplopyx* Brown. Worker (holotype) from Iaraka, Madagascar: head (top) in dorsal view, meso- and metasoma (bottom) in side view.



sternite convex. Constriction between postpetiole and gaster impressed. Gastral tergite I deeply hypertrophied posteriorly (Fig. 35). Remaining gastral tergites and sternites curved ventrally.

Legs slender, elongate. All tibiae with a pectinate spur. Spurs of fore legs with a basal spine. Fore basitarsi as long as the mid ones. Hind basitarsi about 0.8 of the length of the hind tibiae. Second tarsomere of mid and hind legs longer than third and fourth tarsomeres and about as long as the pretarsus. Pretarsal claws simple. Pretarsal arolium small.

Sculpture. Head irregularly reticulorugose; in addition to this sculpture, the frons, the vertex and the sides of the head very irregularly foveolate-granulate. Mesosoma, petiole and postpetiole very irregularly foveolate-granulate, the granulation raised as peaks. First gastral tergite smooth and with sparse granulation. Legs and scapes with dense punctures.

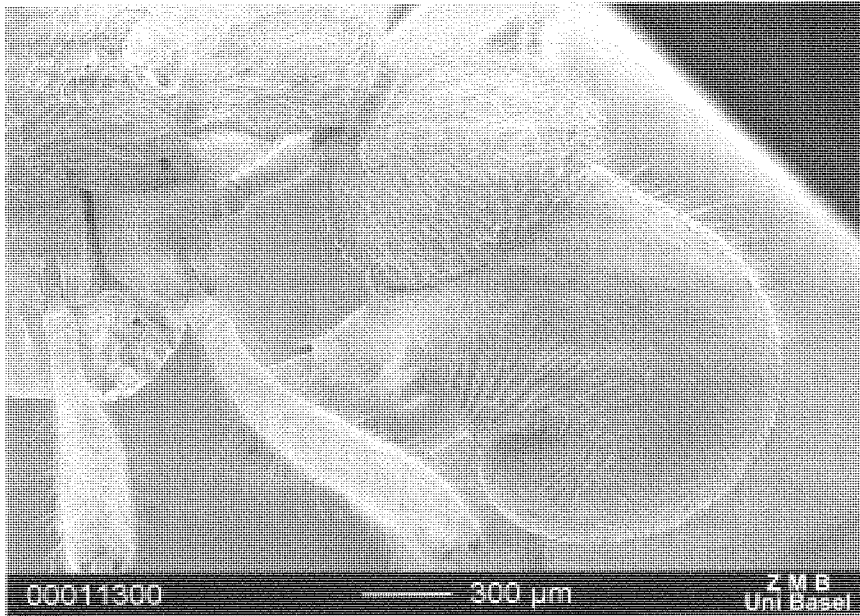


Fig. 35 – *Proceratium diplopyx* Brown. Worker (holotype) from Iaraka, Madagascar: profile of nodes and of the gaster.

Body covered by hairs of three main types: (1) short, dense, subdecumbent on the whole body, erect and sparse on the funicular joints; (2) long, suberect or subdecumbent, sparse on the whole body but absent on the scapes and funicular joints; (3) shorter than hair type (1), dense and decumbent on the funicular joints only. In addition, the funicular joints bear thick, appressed, short, sparse hairs and the scapes sparse hairs shorter than hair type (2).

Colour reddish-brown.

Measurements in mm and Indices: TL 5.86; HL 1.44; HW 1.24; EL 0.12; SL 1.12; WL 1.68; PeL 0.66; PeW 0.48; HFeL 1.52; HTiL 1.24; HBaL 1.00; LS4 0.19; LT4 1.32; CI 86.1; SI 77.8; IGR 0.14.

MATERIAL EXAMINED: MADAGASCAR: Iaraka, 1000 m, Baie d'Antongil, Province de Tamatave, 26.XI.1969, 2 workers (holotype and paratype), J. -M. Betsch [MNHN, MCZC].

DISCUSSION. *P. diplopyx* is the most distinctive species of the *stictum* clade and of the whole genus for the shape of the gastral tergite I (Fig. 35). Brown (1980) suggested to consider *diplopyx* as representing a species group of its own. In spite of the bizarre gastral morphology, however, Brown (l. c.) stressed the affinities of *diplopyx* with his "*stictum* group". In our analysis, *diplopyx* appears as a member of the *stictum* clade with which it shares synapomorphically the basal spine on the protibial spur. If, on one hand, considering the *diplopyx* grotesque gastral shape worthy of a separate group could be considered a matter of taste, on the other hand, its resolved phylogenetic position within the *stictum* clade represents an obstacle to this course of action.

DISTRIBUTION: Madagascar.

**Proceratium avium** Brown

Fig. 36

*Proceratium avium* Brown, 1974: 71, figs. 1 & 2 (worker), partim. Worker. Nec gyne and male (= *avioide*, see later). Original description. Type locality: Mauritius. Type material: 38 workers (holotype and paratypes) partially labelled: "Mauritius, W. L. Brown, 1. Apr. 1969, Le Pouce Mt., 700-800 m, native forest, M252", holotype in MCZC, paratypes in BMNH, CASC, MCZC, MIZA, MZSP, NHMB, all examined.

DIAGNOSIS. A *Proceratium* species belonging to the *avium* group and resulting as sister species of *avioide*, but differing from the latter by the smaller and shallower foveae, by the longer scapes, and by the shorter and denser pilosity.

DESCRIPTION. *Worker* (Fig. 36). Head longer than broad, with subparallel or gently convex sides. Vertex gently convex or straight in full face view. Clypeus broad, convex, protruding anteriorly and surrounding the whole antennal insertions.

Anteromedian margin of the clypeus with or without a variably impressed notch. Frontal carinae separate from each other, parallel and not covering the antennal insertions. Lateral expansions of the frontal carinae narrow and low. Frons concave. Genal carinae superficially marked. Head ventrally with a pair of superficially impressed longitudinal sulci delimited externally by the genal carinae. Gular area weakly concave. Eyes present, composed by a single convex facet each and slightly below the mid-line of the head. Scapes distinctly surpassing the vertexal margin. First funicular joint about 1/4 longer than broad. Funicular joints 2-7 slightly longer than broad, and joints 8-10 about as broad as long. Last funicular joint as long as the sum of joints 7-10. Mandibles with 4-6 denticles. Palp formula 4,3.

Mesosoma elongate, much longer than the head length (mandibles included). Promesonotal and propodeal sutures absent; some specimens with a superficial depression dorsally between the mesonotum and propodeum. Promesopleural and meso-metapleural sutures impressed on the ventral half only. Propodeum unarmed and gently convex in side view. Propodeal lobes subtruncate and apically variably convex. Propodeal spiracle tumuliform, over mid height of the propodeum in lateral view.

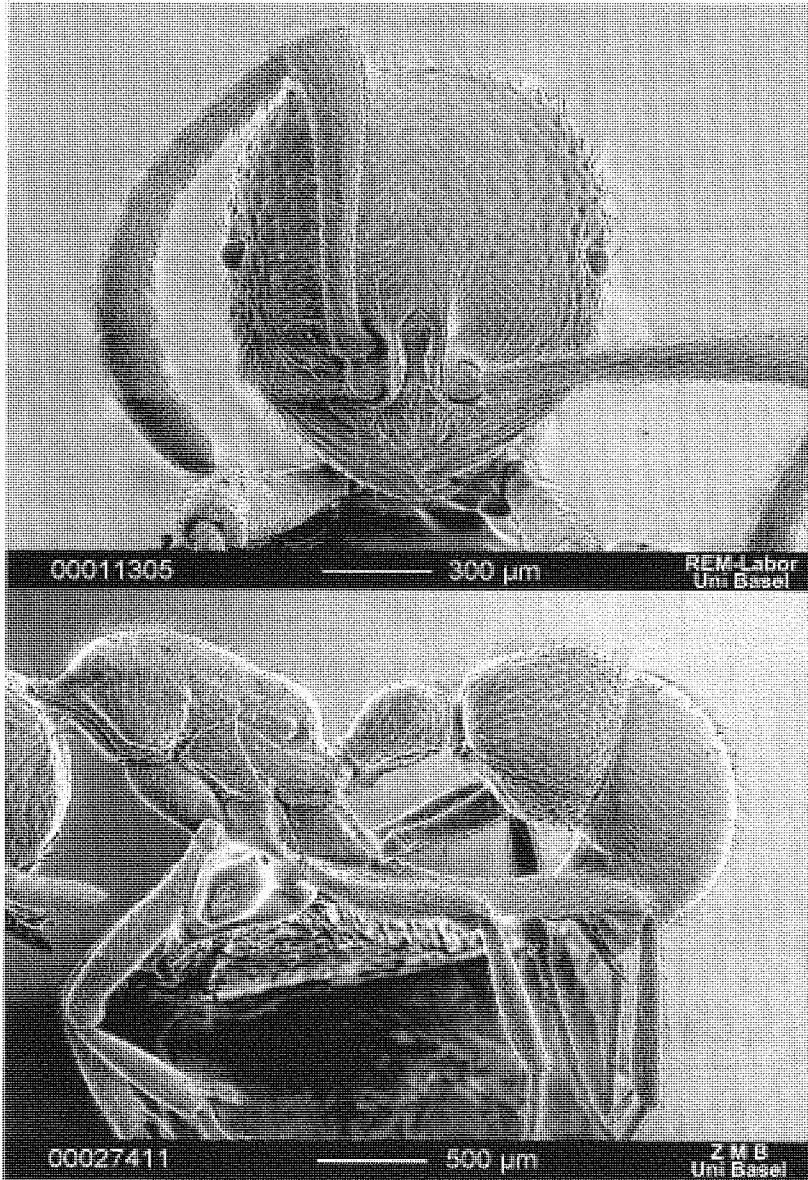


Fig. 36 – *Proceratium avium* Brown. Worker (paratype) from Le Pouce Mountain, Mauritius: head (top) in dorsal view and meso- and metasoma (bottom) in side view.

Petiole about 1/5 longer than broad, with diverging sides on the anterior fourth and convex posteriorly in dorsal view. Anterior border of the petiole gently concave and carinate, the carina denticulate on each side. Ventral process of the petiole longitudinally carinate, the carinae sometimes with two small, subtriangular teeth, the anterior larger and broader than the second, when present. Postpetiole slightly shorter than gastral tergite I (LT4), slightly convex in side view and with the sides diverging backwards in dorsal view. Postpetiolar sternite anteromedially with a marked subtriangular projection. Posterior half of the postpetiolar sternite convex. Constriction between postpetiole and gastral segment I impressed. Gastral tergite I convex. Remaining gastral tergites and sternites slightly curved ventrally.

Legs slender and elongate. All tibiae with a pectinate spur. Spurs of fore legs with a basal spine. Fore basitarsi slightly shorter than the mid ones. Hind basitarsi very long and about 0.9 of the length of the hind tibiae. Second tarsomere of mid and hind legs longer than third and fourth tarsomeres, and about as long as the pretarsus. Pretarsal claws simple. Arolia present but small.

Sculpture. Body largely shining, with sparse, small foveae, denser close to the posterior border of the postpetiole, smaller or absent on the frons, on the dorsum of the mesosoma and of the petiole, rare on the gular area. Sides of the head between clypeus and eyes irregularly rugulose. Gaster with minute piligerous punctures. Legs with dense piligerous punctures.

Body covered by hairs of three main types: (1) short, dense, subdecumbent on the whole body, suberect and sparse on the funicular joints; (2) long, suberect or subdecumbent, sparse on most of the body but absent on the scapes and funicular joints; (3) shorter than hair type (1), dense and decumbent on the funicular joints only. In addition, the funicular joints bear thick, appressed, short, sparse hairs and the scapes sparse, subdecumbent hairs shorter than hair type (2).

Colour reddish or dark yellow-brown with slightly lighter legs; some specimens with darker mandibles and antennae.

Measurements in mm and Indices: TL 4.49-4.78; HL 1.05-1.12; HW 0.90-0.94; EL 0.09-0.10; SL 0.93-0.97; WL 1.34-1.44; PeL 0.53-0.57; PeW 0.40-0.44; HFel 1.12-1.24; HTiL 0.96-1.03; HBaL 0.81-0.88; LS4 0.20-0.22; LT4 0.74-0.78; CI 84.5-85.7; SI 87.3-88.6; IGR 0.27-0.29.

MATERIAL EXAMINED: MAURITIUS: Le Pouce Mt., 700-800 m, native forest, 1.IV.1969, colony M-252 and non-numbered colony, 34 workers (holotype and paratypes), W. L. Brown [BMNH, CASC, MCZC, MIZA, MZSP, NHMB].

DISCUSSION. Brown (1974) already noticed the differences between the specimens of "*avium*" originating from a colony he collected on March 30 from those of another series he collected on April 1st. Specimens from both collections were available during the present study and we regard the differences between them as worth specific separation. Our opinion is drawn from two main facts: (i) the differences between the two series are consistent within a relatively broad sample of specimens (34 *avium* workers and 16 *avioide* workers from two colonies) and, (ii) the two species are sympatric. *Avium* (Fig. 36) differs from its sister species *avioide* (Fig. 37) mainly by the less impressed sculpture, by the denser pilosity and by longer antennal scapes (*avium* SI>86; *avioide* SI<84). Both species differ from all the other members of the *stictum* clade by sharing the body largely shining and regularly foveolate. *Avium* and *avioide* share with their outgroup species, *diplopyx*, the legs slender than those of the other species of the clade.

DISTRIBUTION: Mauritius.

***Proceratium avioide* de Andrade n. sp.**

Figs. 37, 38

*Proceratium avium* Brown, 1974: 71. Worker partim, gyne and male. Misidentification.

TYPE MATERIAL: 15 workers (holotype and paratypes), one ergatoid gyne (paratype) and one male (allotype) labelled: "Le Pouce Mt., 700-800 m., native forest, Mauritius, W. L. Brown, 30.III.1969, ICA-69", holotype, gyne and male in MCZC, remaining worker paratypes in MCZC and LACM.

DERIVATIO NOMINIS: the existing species name *avium* and the Latin suffix *-oides* to stress the similarity between this species and *avium*, compose *avioide*.

DIAGNOSIS. A *Proceratium* species belonging to the *avium* group, resulting as sister species of *avium*, but differing from it by the larger and deeper foveae, by the shorter scapes, and by the longer and sparser pilosity.

DESCRIPTION. *Worker* (Fig. 37). Very similar to *avium* but differing from it in the following details: anteromedian clypeal border sometimes without a notch; genal carinae more marked; longitudinal sulci deeper; scapes shorter; mesosoma more robust; basal face of the propodeum less convex; sides between basal and declivous faces of the propodeum weakly angulate and superficially marginate; propodeal lobes broader and more convex; propodeal spiracles smaller and less protrudent; petiolar node slightly broader and more convex; postpetiole slightly longer than the gastral tergite I (LT4), with a broad tumulus posteriorly in side view; gastral tergite I weakly convex; remaining gastral tergites and sternites more curved ventrally.

Sculpture: body much more smooth and shining; foveae on the head, on the mesosoma, on the petiole and on the postpetiole deeper and larger, more impressed on the frons, on the dorsum of the mesosoma and on the petiole.

Body covered by hairs of three main types: (1) short, sparser than in *avium*; (2) long, slightly denser and longer than in *avium*; (3) shorter than hair type (1), dense and decumbent on the funicular joints only. In addition, the funicular joints bear thick, appressed, short, sparse hairs and the scapes sparse, subdecumbent hairs shorter than hair type (2).

Colour light or dark ferrugineous with slightly lighter legs.

Measurements in mm and Indices: TL 4.63-4.77; HL 1.10-1.16; HW 0.92-0.97; EL 0.09-0.10; SL 0.90-0.96; WL 1.38-1.48; PeL 0.56-0.58; PeW 0.45-0.46; HFeL 1.12-1.18; HTiL 0.93-0.99; HBaL 0.76-0.83; LS4 0.22-0.23; LT4 0.65-0.70; CI 82.1-85.1; SI 81.8-83.3; IGR 0.31-0.34.

*Gyne*. Head longer than broad, with sides slightly broader posteriorly. Vertex gently convex in full face view. Clypeus broad, convex, protruding anteriorly and surrounding the whole antennal insertions. Anteromedian margin of the clypeus with a superficial notch. Frontal carinae separate from each other, parallel and not covering the antennal insertions. Lateral expansions of the frontal carinae narrow and low. Genal carinae marked. Head ventrally with a pair of superficially impressed longitudinal sulci de-

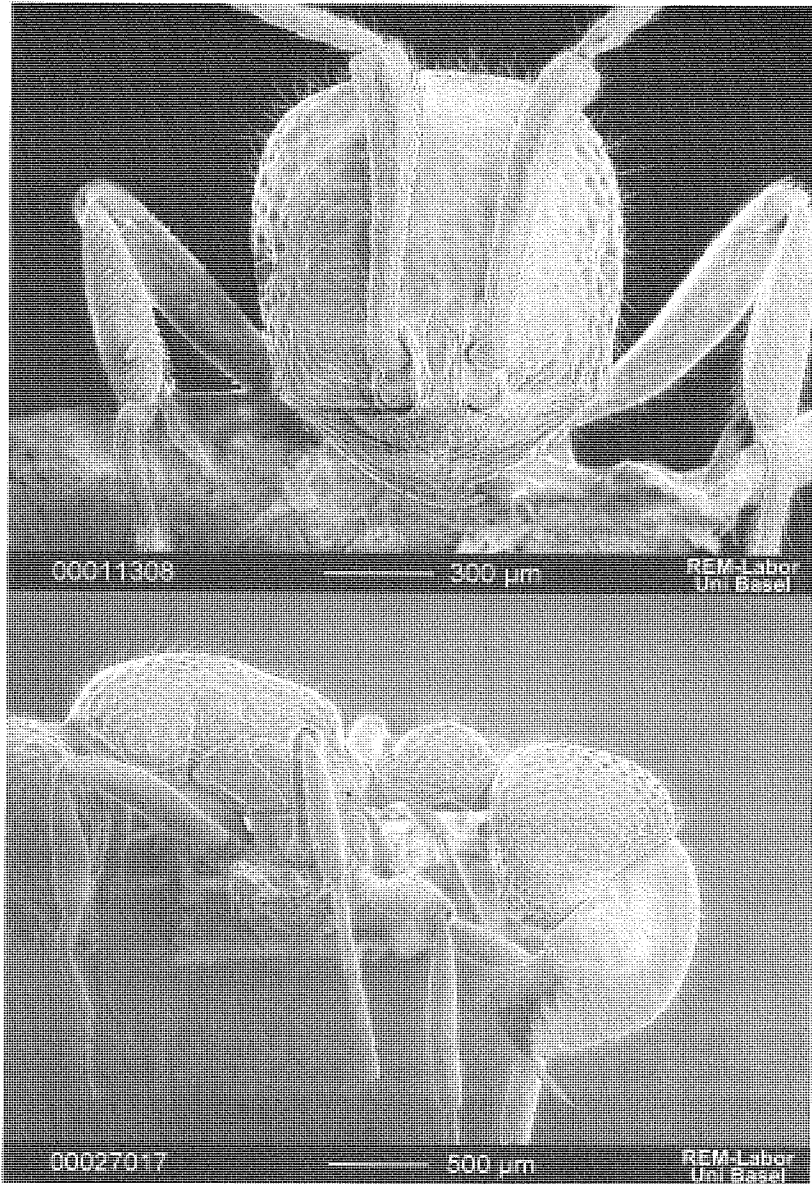


Fig. 37 – *Proceratium avioide* de Andrade. Worker (paratype) from Le Pouce Mountain, Mauritius: head (top) in dorsal view and meso- and metasoma (bottom) in side view.



limited externally by the genal carinae. Gular area weakly concave. Eyes small,  $1/7$  of the head length, with few interommatidial hairs, placed on the mid-line of the head. Ocelli small. Scapes reaching the vertexal margin. First funicular joint slightly less than  $1/3$  longer than broad. Funicular joints 2-10 about as broad as long. Last funicular joint slightly shorter than the sum of joints 7-10. Mandibles with 6 denticles. Palp formula 4,3.

Mesosoma not very robust, in side view slightly convex. Scutellum not clearly separate from the mesonotum; its sides converging to a convex posterior border. Metanotum with a subpointed, small tooth. Basal face of the propodeum declivous posteriorly and medially gently concave. Propodeal sides between basal and declivous faces slightly angulate. Propodeal lobes apically convex.

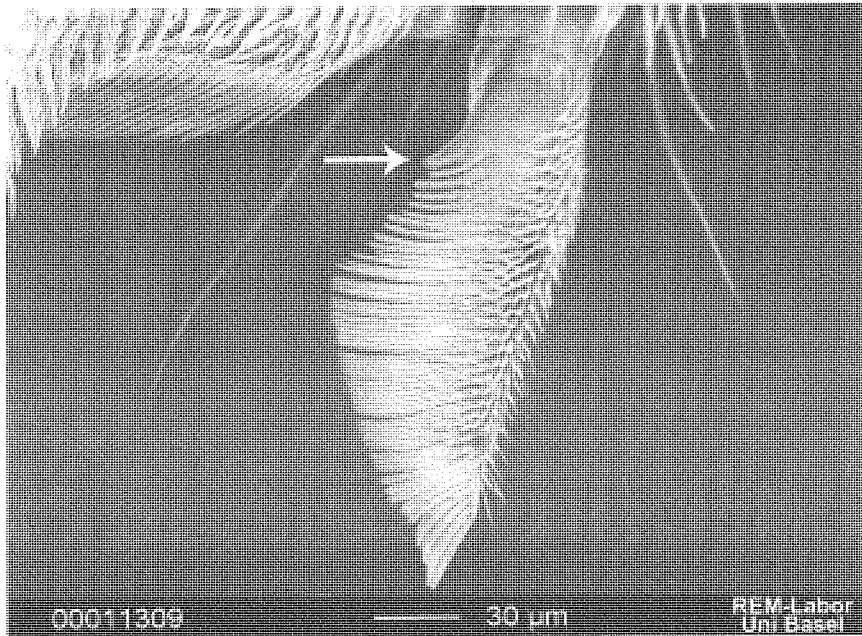


Fig. 38 – *Proceratium avioide* de Andrade. Worker (paratype) from Le Pouce Mountain, Mauritius: right fore tibial spur with basal spine shown by the arrow.

Petiole about as broad as long, in side and dorsal views convex, in dorsal view with the sides diverging on the anterior fifth and strongly convex posteriorly. Anterior border of the petiole gently concave and laterally with a carinate denticle. Ventral process of the petiole minutely denticulate. Postpetiole shorter than gastral tergite I (LT4) in profile and convex in dorsal view. Postpetiolar sternite anteromedially with a marked subtriangular projection. Posterior half of the postpetiolar sternite convex. Constriction between postpetiole and gastral segment I impressed. Gastral tergite I convex. Remaining gastral tergites and sternites slightly curved ventrally.

Legs slender and elongate. All tibiae with a pectinate spur. Spurs of fore legs with a basal spine (Fig. 38). Fore basitarsi subequal in size to the mid ones. Hind basitarsi very long and about 0.8 as long as the hind tibiae. Second tarsomere of mid and hind legs longer than third and fourth tarsomeres, and about as long as the pretarsus. Pretarsal claws simple. Arolia small.

Sculpture. Body generally smooth and shining. In addition, the sides of the head with large foveae, the frons and mesosoma with small, superficial, very sparse foveae.

Body covered by hairs of three main types: (1) short, subdecumbent, sparse on the head, on the mesosoma and on the petiole, suberect and sparse on the funicular joints, dense on the postpetiole, gaster and legs; (2) very long (longer than in the worker), flexuous and sparse on the head, on the mesosoma, on the petiole and on the legs, slightly shorter, less flexuous and rare on the postpetiole and gaster, absent on the scapes and funicular joints; (3) shorter than hair type (1), dense and decumbent on the funicular joints only. In addition, the funicular joints bear thick, appressed, short, sparse hairs and the scapes sparse, subdecumbent hairs shorter than hair type (2).

Colour light reddish with lighter antennae and legs.

Measurements in mm and Indices: TL 4.86; HL 1.08; HW 0.91; EL 0.15; SL 0.84; WL 1.34; PeL 0.56; PeW 0.57; HFeL 1.04; HTiL 0.86; HBaL 0.70; LS4 0.28; LT4 0.98; CI 84.2; SI 77.7; IGR 0.29.

*Male.* Head longer than broad. Vertex convex. Clypeus anteromedially strongly projecting and truncate. Frontal carinae thin, low, parallel and far each other. Ocelli large. Compound eyes very large, strongly convex and

positioned slightly before the center of the head sides. Scapes slightly surpassing the vertexal margin. First funicular joint about half as long as the second. Joints 2-11 subequal in length and width. Apical joint as long as the sum of joints 10-11. Mandibles slender, minutely and irregularly denticulate and with a pointed apical tooth each. Palp formula 4,3.

Mesosoma robust. Pronotum and anterior third of mesonotum almost perpendicular to the posterior two thirds. Posterior two thirds of mesonotum gently convex. Parapsidal furrows superficially marked. Scutellum convex and slightly higher than the mesonotum; posterior border of scutellum strongly rounded. Propodeum with slightly convex basal face and truncate declivous face. Declivous face of propodeum weakly marginate on the sides. Metanotum with a strong median spine-like projection. Propodeal lobes convex.

Petiole 1/3 longer than broad, broader on the posterior half. Anterior border of the petiole superficially concave and marginate. Subpetiolar process absent; only a longitudinal carina is present. Postpetiole anteriorly slightly broader than the petiole; postpetiolar sides diverging posteriorly.

Gastral tergite I gently convex.

Legs slightly longer and slender than in the worker and the gyne.

Fore wings of our type 5, hind wings of our type 2 as defined in the description of the genus.

Sculpture. Body smooth and shining. Head with variably clumped foveae, larger and deeper behind the eyes. Anterior border of the eyes with few, thin, longitudinal rugosities. Pronotum and mesonotum with sparse foveae, denser, smaller and separated by few longitudinal rugosities on the center of its anterior third. Scutellum with foveae similar to those behind the eyes but denser. Propodeum with small, dense, irregular foveae, sparser on the lower metapleurae, absent on the posterior half of the declivous face. Postpetiole with very superficial, sparse foveae, denser and irregular on the postpetiolar sternite. Gastral tergite I and legs with piligerous foveae, larger on the anterior half of the gaster, denser on the legs.

Body covered by hairs of three main types: (1) short, subdecumbent, sparse to dense on the head, on the mesosoma, on the petiole, on the gaster, dense and decumbent on the scapes and on the legs; (2) long, thick, sparse, erect or suberect on the head, on the mesosoma, on the gaster, very sparse on the petiole, on the postpetiole, sparse and decumbent on the legs; (3) shorter than hair type (1), dense and decumbent on the funicular joints only.

In addition, the scapes bear very sparse hairs, thinner and shorter than type (2), and the funicular joints bear thick, appressed, short, sparse hairs.

Colour. Dark yellow to light brown with the posterior half of the head dorsum and of the gaster darker.

Measurements in mm and Indices: TL 4.62; HL 0.85; HW 0.72; EL 0.40; SL 0.65; WL 1.56; PeL 0.54; PeW 0.36; HFeL 1.18; HTiL 0.92; HBaL 0.80; LS4 0.32; LT4 0.85; CI 84.7; SI 76.5; IGR 0.38.

MATERIAL EXAMINED. MAURITIUS: Le Pouce Mt. 700-800 m, 30.III.1969, ICA-69, native forest, 1 worker (holotype) [MCZC], 14 workers, 1 ergatoid gyne, and 1 male (all paratypes), W. L. Brown [LACM, MCZC, MHNG]; Le Pouce Mt. 700-800 m, native forest, 4.III(?)1977, 1 worker, W. L. Brown [MCZC].

DISCUSSION. *P. avioide* is very similar to *avium* but the characters listed in the diagnosis can be easily used to separate all known specimens of both species without hesitation. We verified their constancy among 34 *avium* and 16 *avioide* specimens. Since there are no known transitional forms between these two morphologies and since both morphologies coexist in narrow sympatry on Mauritius, there seems to be no alternative to considering them as two valid species. According to Brown (1974) *avium* and *avioide* nest in dead tree branches.

DISTRIBUTION: Mauritius.

### ***Proceratium stictum* Brown**

Figs. 39, 40, 41

*Proceratium stictum* Brown, 1958a: 336, figs. 45 & 46. Worker. Original description. Type locality: Australia. Type material: one worker (holotype) labelled: "Kuranda, N. Qld., XI.1.50, W. L. Brown, rotten log rain forest, M.C.Z. Htype 29871", in MCZC, examined.

DIAGNOSIS. A *Proceratium* species resulting in an unresolved position within a three-species clade containing also *deelemani* and *foveolatum*. It resembles especially *deelemani* from which it differs by the frontal carinae

less divergent posteriorly, by the longer hind basitarsi ( $HTiL/HBaL \leq 1.19$  instead of  $\geq 1.28$ ) and by the more superficial cephalic sculpture.

**DESCRIPTION.** *Worker* (Fig. 39). Head slightly longer than broad, narrower anteriorly than posteriorly. Vertex in full face view gently convex. Clypeus broad, convex, protruding anteriorly and surrounding the whole antennal insertions. Anteromedian margin of the clypeus with a notch. Frontal carinae far from each other, subparallel and not covering the antennal insertions. Floor of the frontal carinae concave medially. Lateral expansions of the frontal carinae narrow and slightly raised. Frons medially concave. Genal carinae present, strongly marked, prolonging towards the hypostomal bridge and bounding an impressed gular area. A superficial sulcus is present between the genal carinae and the gular area. Eyes present and composed of a small, clearly convex ommatidium slightly below the midline of the head. Scapes thick, distally incrassate, and not attaining the vertexal margin. First funicular joint about 1/4 longer than broad. Funicular joints 2-10 slightly broader than long. Last funicular joint as long as the sum of joints 7-10. Mandibles with 3 denticles before the apical tooth. Palp formula 4,3.

Mesosoma about as long as the head (mandibles included), convex in side view. Promesonotal and propodeal sutures absent. Promesopleural and meso-metapleural sutures impressed on the ventral half only. Basal face of the propodeum declivous posteriorly. Declivous face of the propodeum flat, sides of the declivous face weakly marginate, the margin more marked posteriorly. Propodeum with a pair of spines between basal and declivous faces. Propodeal lobes ventrally truncate and dorsally with a subround tooth protruding dorsally. Propodeal spiracle round and above the mid-height in lateral view.

Petiole about 0.1 longer than broad. Petiole in dorsal view subparallel in the anterior third and convex posteriorly. Anterior border of the petiole slightly concave, with a superficial margin denticulate on each side. Ventral process of the petiole lamellaceous and with 1-3 denticles of variable size. Postpetiole slightly shorter than gastral tergite I (LT4). Postpetiole in side view only slightly convex distally and in dorsal view with the sides gently convex. Postpetiolar sternite anteromedially with a marked subtriangular projection. Posterior half of the postpetiolar sternite slightly convex. Con-

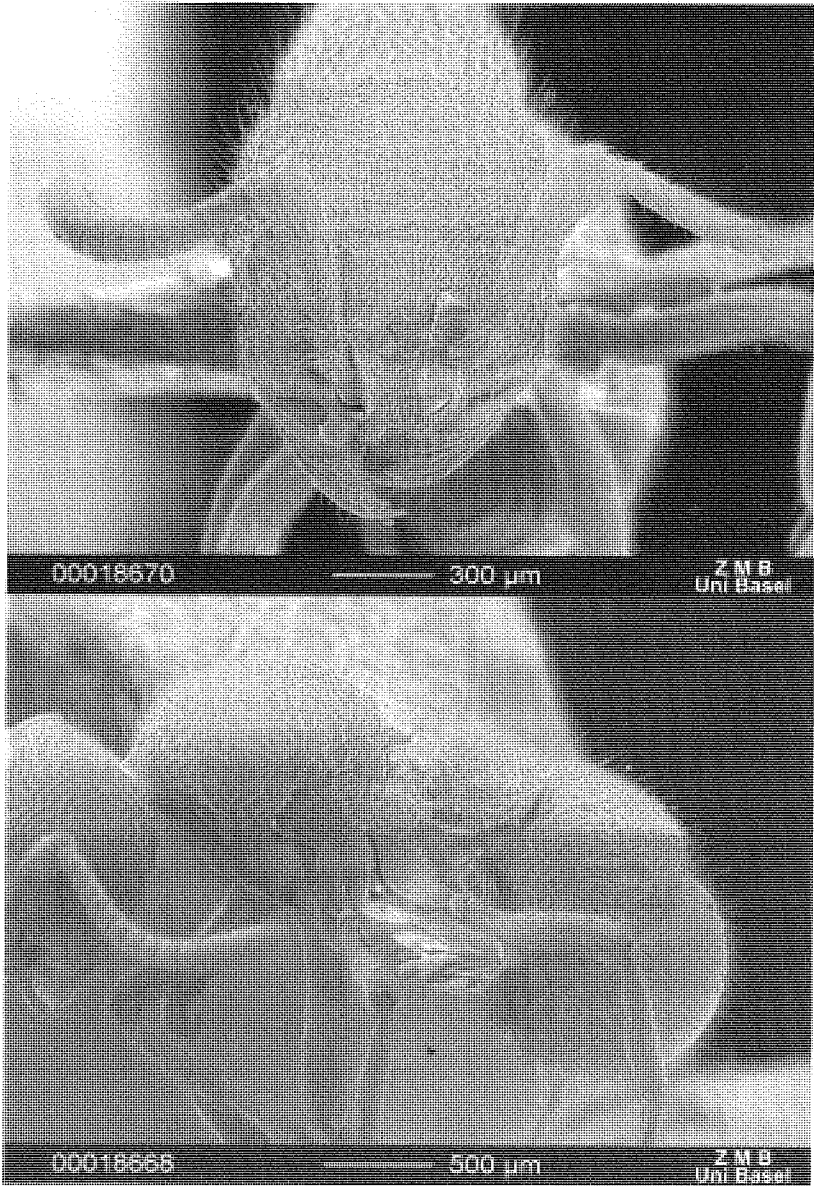


Fig. 39 – *Proceratium stictum* Brown. Worker (holotype) from Kuranda, Queensland, Australia: head (top) in dorsal view and meso- and metasoma (bottom) in side view.

striction between postpetiole and gastral segment I impressed. Gastral tergite I strongly convex on the curvature. Gastral sternite I very short medially. Remaining gastral tergites and sternites slightly curved ventrally.

Legs elongate. All tibiae with a pectinate spur. Spurs of fore legs with a basal spine. Fore basitarsi slightly longer than the mid ones. Hind basitarsi about 0.9 of the length of the hind tibiae. Second tarsomere of mid and hind legs longer than third and fourth tarsomeres, and slightly shorter than pretarsus. Pretarsal claws simple. Arolia present but small.

Sculpture. Head rugulose, granulopunctate, this sculptures superimposed by irregular foveae, the foveae very rare on the two anterior thirds of the head. Mesosoma, petiole and postpetiole granulopunctate and with variably impressed irregular foveae. Gaster with relatively large piligerous foveae, denser on the sides. Scapes and legs granulopunctate.

Body covered by hairs of three main types: (1) short, dense, subdecumbent to suberect on the whole body, sparse on the funicular joints; (2) suberect, long on the whole body, absent from the antennae; (3) shorter than hair type (1), dense, decumbent or appressed on the funicular joints only. In addition the funicular joints bear whitish, thick, appressed, short, sparse hairs and the scapes sparse hairs shorter than hair type (2).

Colour ferrugineous.

Measurements in mm and Indices: TL 3.51-4.47; HL 0.83-1.04; HW 0.73-0.96; EL 0.06-0.07; SL 0.58-0.76; WL 0.97-1.28; PeL 0.40-0.51; PeW 0.34-0.46; HFeL 0.69-0.89; HTiL 0.56-0.72; HBaL 0.47-0.62; LS4 0.15-0.20; LT4 0.63-0.78; CI 87.9-92.3; SI 69.9-73.1; IGR 0.24-0.26.

*Male* (tentative attribution) (Fig. 40). Head about as long as broad. Vertex in full face view convex and in full dorsal view weakly flat. Vertexal margin medially narrowly carinate. Clypeus convex and superficially notched medially. Frontal carinae thin, low, parallel and far each other. Frons weakly impressed. Ocelli very large. Compound eyes also very large, larger than in any other male of the *stictum* clade, strongly convex and occupying almost the whole head sides. Scapes reaching the anterior border of the anterior ocellus. First funicular joint about 1/3 of the length of the second joint. Joints 2-11 longer than broad. Last funicular joint shorter than the sum of joints 10-11. Mandibles as in *deelemani*, longer than in *foveolatum*, edentate and only with a pointed apical tooth. Palp formula 4,3.

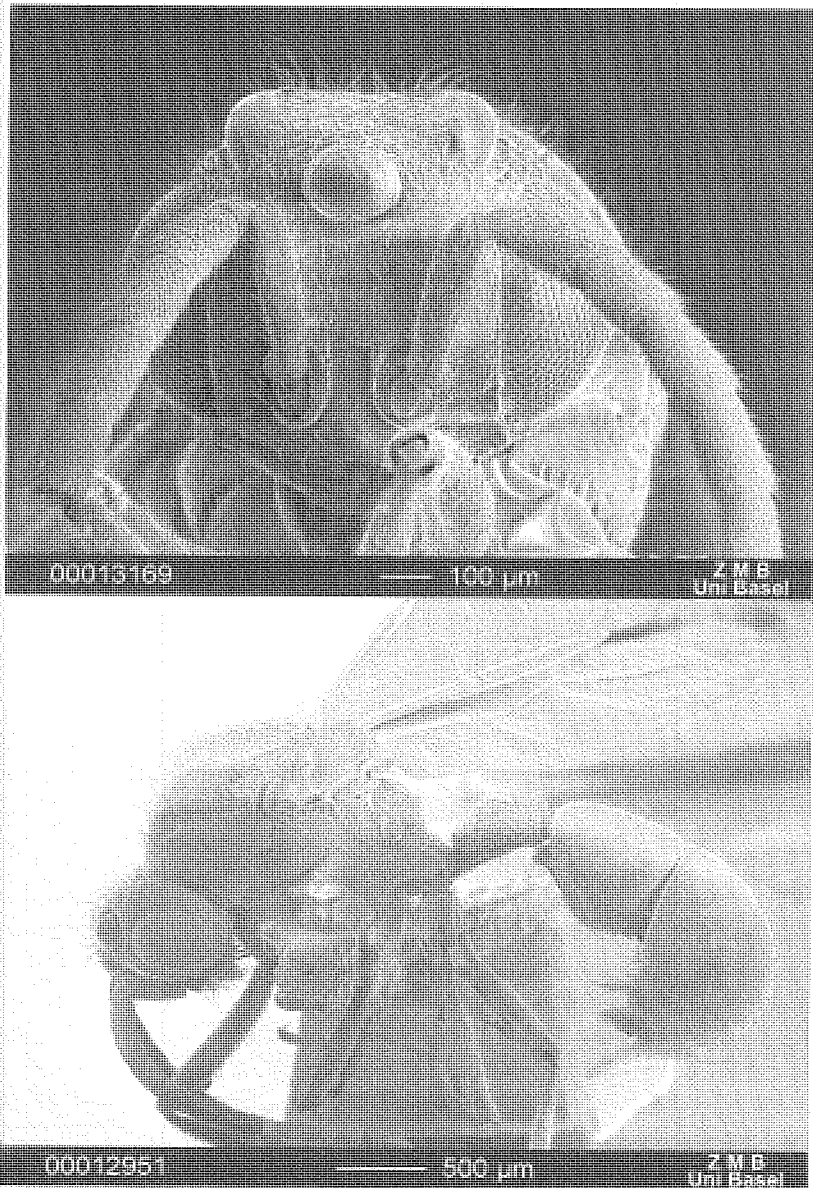


Fig. 40 – *Proceratium stictum* Brown. Male from nr. Brookdale, Queensland, Australia: head (top) in dorsal view and meso- and metasoma (bottom) in side view.



Mesosoma robust. Pronotum and anterior third of mesonotum almost perpendicular to the posterior two thirds of the mesonotum. Posterior two thirds of mesonotum almost flat. Parapsidal furrows superficially marked. Scutellum as high as the mesonotum, its posterior border subround. Sides of the basal face of the propodeum converging posteriorly, ending in an angle and separated each other by a narrow, superficial incision. Declivous face of propodeum flat. Propleurae with a broad posterior incision. Metanotum with a median spine-like projection. Propodeal lobes small and subround. Propodeal spiracles small.

Petiole in side view convex, about 1/5 longer than broad. Sides of the petiole in dorsal view parallel in the anterior third and gently convex posteriorly. Anterior border of the petiole with a median concavity separated by a swelling on each side. Subpetiolar process absent. Postpetiole anteriorly slightly broader than the petiole; postpetiolar sides diverging posteriorly. Anterior border of the postpetiolar sternite with a projecting triangular edge connected to a short carina. Posterior half of the postpetiolar sternite with a broad swelling.

Gastral tergite I round. Gastral sternite I thicker than in *foveolatum*. Remaining gastral tergites and sternites slightly curved ventrally.

Legs less stout than in the worker.

Fore wings of our type 3, hind wings of our type 2 as defined in the description of the genus.

Genitalia as in Fig. 41.

Sculpture. Body largely smooth and with minute piligerous punctures, this sculpture larger and resembling small foveae between and around the ocelli, on the center of the mesosoma, on the whole scutellum, on the basal face of the propodeum and on the petiole. Pro- and mesopleurae with sparse, superficial, small, foveae. Metapleurae with dense irregular foveae.

Pilosity as in the worker but with the hair type (1) sparser and the hair type (2) shorter on the dorsum of the pronotum, of the mesonotum, of the petiole and of the postpetiole, and on the legs.

Colour. Brown with lighter antennae and legs.

Measurements in mm and Indices: TL 4.41-4.58; HL 0.74-0.76; HW 0.70-0.74; EL 0.52-0.53; SL 0.36-0.38; WL 1.56-1.64; PeL 0.47-0.49; PeW 0.40-0.44; HFel 0.99-1.00; HTiL 0.80-0.81; HBaL 0.66-0.68; LS4 0.32-0.34; LT4 0.80-0.90; CI 94.6-97.4; SI 50.0; IGR 0.38-0.40.

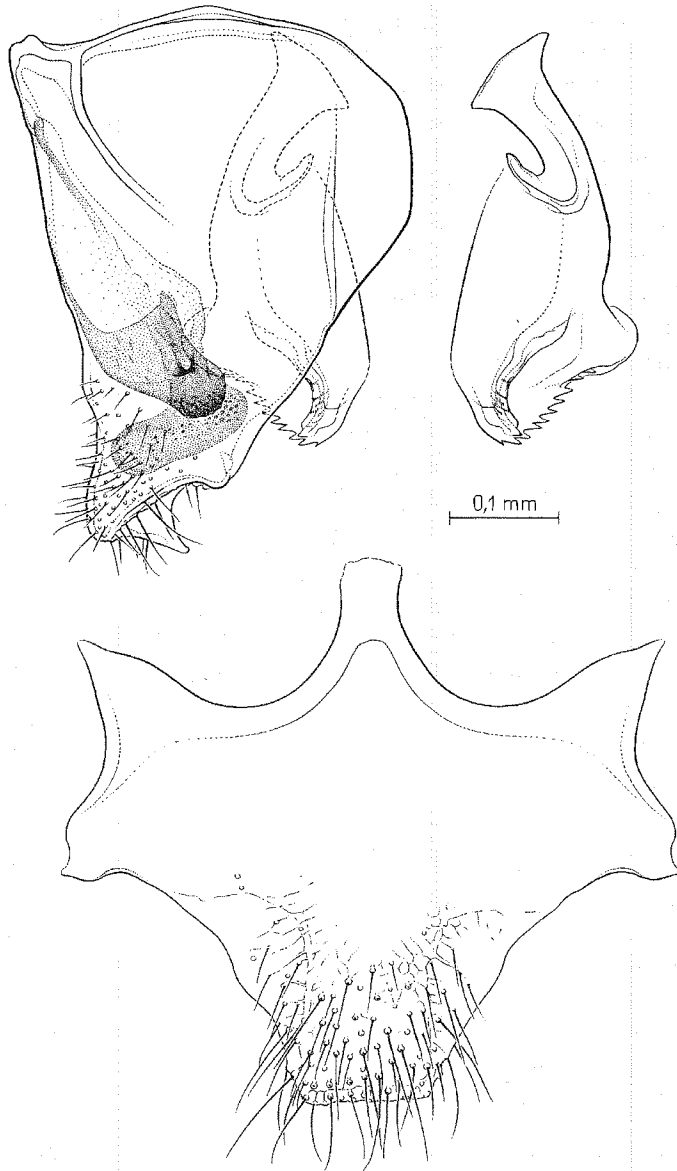


Fig. 41 – *Proceratium stictum* Brown. Male from nr. Brookdale, Queensland, Australia. Genital appendages: a) lateral view of left parameres and of their relative positions; b) right aedeagus in profile; c) subgenital plate in ventral view.

MATERIAL EXAMINED: AUSTRALIA: QUEENSLAND: Kuranda, 370 m, 1.XI.1950, 1 worker (holotype), rotten log rain forest, W. L. Brown [MCZC]; near Brookdale, 10 m, 2.XI.1962, 4 males, E. S. Ross & D. Cavnano [CASC, MCZC]; Thornton Range, 100 m, 23.VI.1971, rainforest, 1 worker, Taylor & Feehan [ANIC]; Mossman Gorge, 20.X.1980, rainforest sieved litter, 1 worker, G. Monteith [ANIC]; 15.04 S 145.07 E, Mt. Webb Nat. Park, 27-30.IV.1981, rainforest litter, 3 workers, A. Calder & J. Feehan [ANIC]; 16.03 S to 16.05 S 145.28 E, Cape Tribulation area, 21-28.III.1984, lowland rainforest, 1 worker, A. Calder & T. Weir [ANIC]; 12.43 S 143.18 E, 11 km ENE of Mt. Tozer, 11-16.VII.1986, 1 worker, rainforest litter, T. Weier [ANIC].

DISCUSSION. *P. stictum* results in an unresolved position with two other species of the *goliath* group. Among the species of this group, *stictum* resembles *deelemani* in general morphology.

Six of the seven workers of *stictum* examined by us differ from the holotype by their smaller size. The worker from 11 km ENE of Mt. Tozer differs from all the other *stictum* workers not only by the smaller size (TL 3.51 mm instead of TL  $\geq$  4.2 mm) but also by the smaller propodeal spines and lobes.

We follow Brown (1974) in tentatively attributing the males from Brookdale to *stictum*. Besides general similarities, these males belong to the *stictum* clade and *stictum* is the sole species of the *stictum* clade recorded from Queensland so far.

DISTRIBUTION: Australia.

### **Proceratium deelemani** Perrault

Figs. 42, 43, 44, 45, 46, 47

*Proceratium deelemani* Perrault, 1981: 189, figs. 1-6. Worker. Original description. Type locality: Borneo. Type material: holotype worker labelled: "Borneo, 16-7-1979, Sepakan, Balikpapan, RC Deeleman, Type", in MNHN, examined.

*Proceratium* sp. Bolton, 1994: 169, figs. 444 & 445 (worker).

DIAGNOSIS. A *Proceratium* species belonging to the *goliath* group and in an unresolved position in a small group containing two other species, *stictum* and *foveolatum*, but resembling more *stictum*, and differing from it in the worker by the frontal carinae more divergent posteriorly, by the shorter hind basitarsi ( $HTiL/HBaL \geq 1.28$  instead of  $\leq 1.19$ ) and by the head sculpture deeper.

DESCRIPTION. *Worker* (Figs. 42, 43, 44 & 47). Head slightly longer than broad, narrower anteriorly than posteriorly. Vertex in full face view almost straight. Clypeus broad, convex, protruding anteriorly and surrounding the whole antennal insertions. Anteromedian margin of the clypeus notched medially. Frontal carinae far from each other, strongly diverging posteriorly and not covering the antennal insertions. Floor of the frontal carinae concave medially. Lateral expansions of the frontal carinae narrow and slightly raised. Genal carinae present, strongly marked, prolonging towards the hypostomal bridge and bounding an impressed gular area. A superficial sulcus is present between the genal carinae and the gular area. Eyes present, composed by a convex facet each, and placed slightly below the mid line of the head. Ocelli absent. Scapes thick, distally incrassate, and far short of the vertexal margin. First funicular joint as broad as long. Funicular joints 2-10 broader than long. Last funicular joint as long as the sum of joints 7-11. Mandibles with 3 denticles before the apical tooth. Palp formula 4,3 (Fig. 44).

Mesosoma slightly longer than the head (mandibles included), convex in side view. Promesonotal and propodeal sutures weakly impressed. Promesopleural suture impressed on the ventral half only. Basal face of the propodeum slightly convex and declivous posteriorly. Declivous face of the propodeum flat; sides of the declivous face marginate. Propodeum with a pair of relatively long, large spines between the basal and declivous faces. Propodeal lobes ventrally truncate and dorsally with a long, round tooth protruding dorsally. Postero-median part of the metapleurae with a superficial concavity sheltering the propodeal spiracle. Propodeal spiracles large or small (see discussion).

Petiole about as broad as long, in dorsal view with the sides diverging on the anterior third and convex posteriorly. Anterior border of the petiole straight and with a thick margin slightly denticulate on each side. Ventral

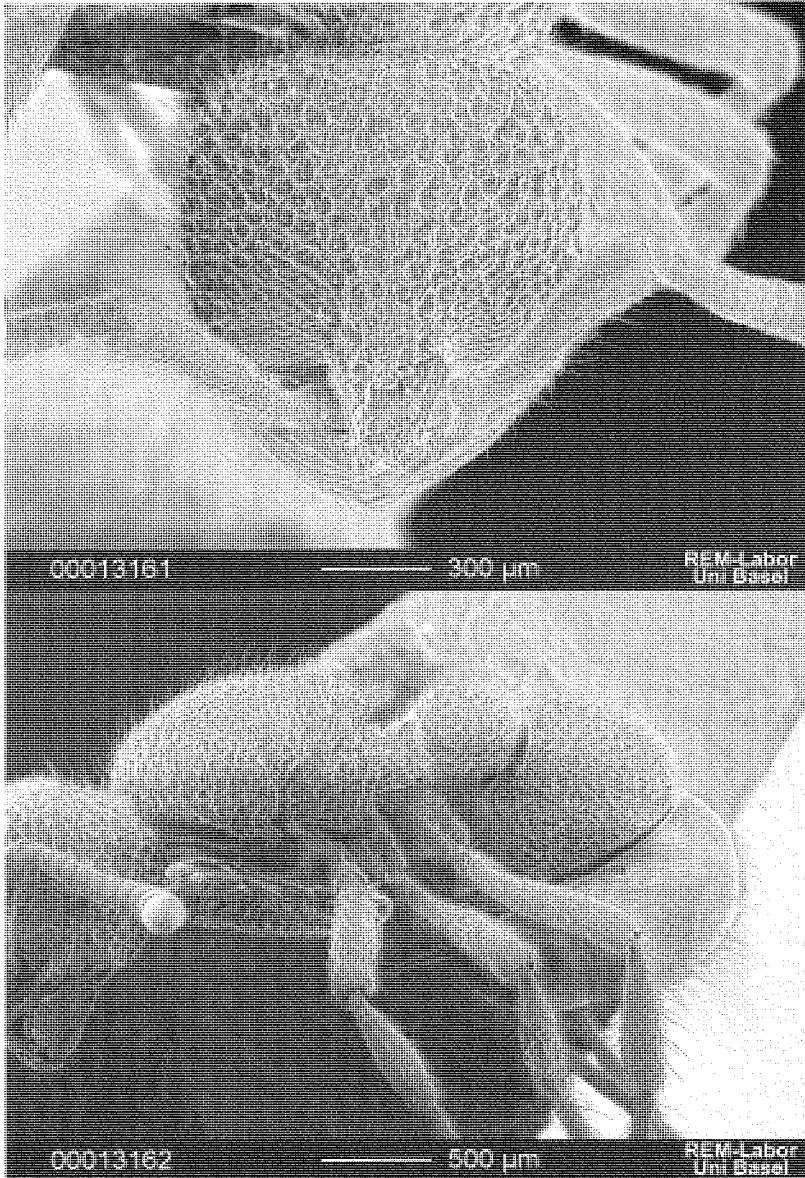


Fig. 42 – *Proceratium deelemani* Perrault. Worker from Posing Hot Springs, Sabah: head (top) in dorsal view and meso- and metasoma (bottom) in side view.

process of the petiole corresponding to a longitudinal lamella posteriorly denticulate. Postpetiole slightly shorter than gastral tergite I (LT4). Postpetiole in side view with a tumulus close to the posterior border and in dorsal view with broadly convex sides. Postpetiolar sternite anteromedially with a marked subtriangular projection. Posterior half of the postpetiolar sternite slightly convex. Constriction between postpetiole and gastral segment I deeply impressed. Gastral tergite I strongly rounded. Gastral sternite I very short medially. Remaining gastral tergites and sternites curved ventrally.

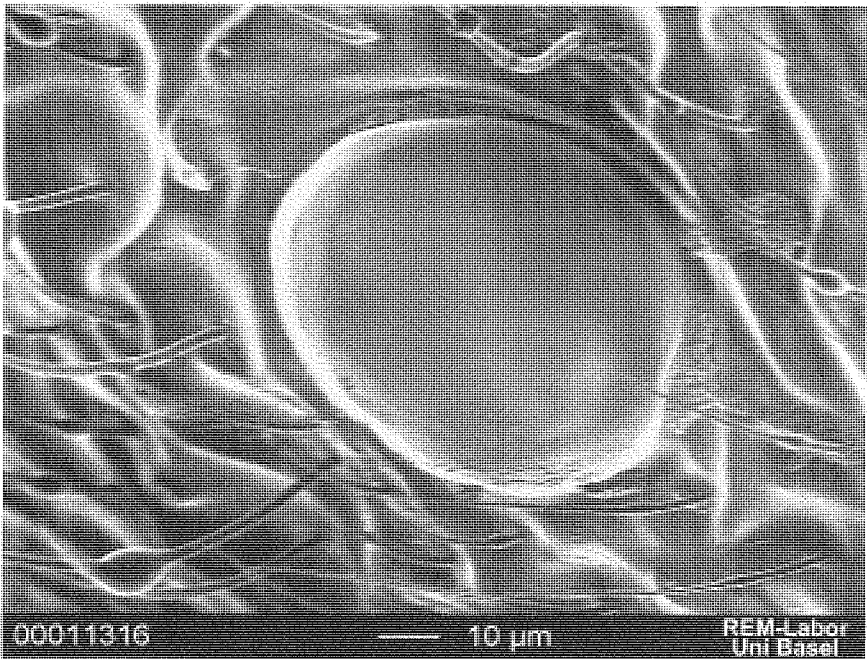


Fig. 43 – *Proceratium deelemani* Perrault. Worker from Nakhon Ratchasima, Thailand: left eye.

Legs elongate. All tibiae with a pectinate spur. Spurs of fore legs with a basal spine. Fore basitarsi slightly longer than the mid ones. Hind basitarsi about 0.75 of the length of the hind tibiae. Second tarsomere of mid and hind legs longer than third and fourth tarsomeres, and shorter than pretarsus. Pretarsal claws simple. Arolia small.

Sculpture. Head, mesosoma, petiole and postpetiole foveolate with superimposed punctation and granulation, the foveae deep, relatively large and irregular. Gaster smooth, its sides and posterior border granulopunctate and slightly foveolate-rugulose. Scapes and legs strongly granulate.



Fig. 44 – *Proceratium deelemani* Perrault. Worker from Nakhon Ratchasima, Thailand: maxillary and labial palps.

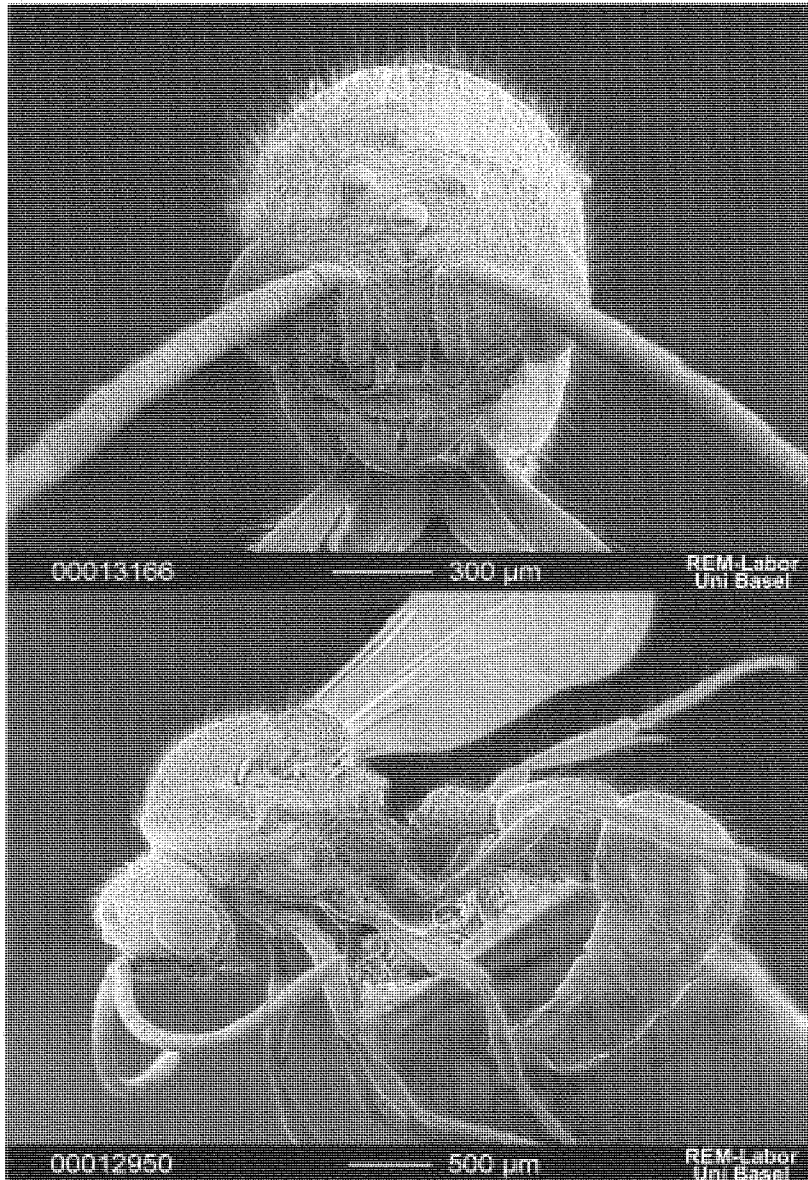


Fig. 45 – *Proceratium deelemanii* Perrault. Male from Ulu Temburong, Brunei: head (top) in dorsal view and meso- and metasoma (bottom) in side view.



Body covered by hairs of three main types: (1) short, dense, subdecumbent on the whole body, suberect and sparse on the funicular joints; (2) suberect, long, relatively dense on the whole body, absent from the antennae; (3) shorter than hair type (1), dense, decumbent or appressed on the funicular joints only. In addition the funicular joints bear whitish, thick, appressed, short, sparse hairs and the scapes with sparse hairs shorter than hair type (2).

Colour dark ferrugineous-brown with lighter legs.

Measurements in mm and Indices: TL 3.87-4.68; HL 0.92-1.14; HW 0.88-1.10; EL 0.07-0.08; SL 0.61-0.78; WL 1.08-1.40; PeL 0.41-0.53; PeW 0.37-0.52; HFeL 0.73-1.04; HTiL 0.63-0.86; HBaL 0.45-0.67; LS4 0.16-0.22; LT4 0.68-0.82; CI 92.6-96.7; SI 62.4-68.5; IGR 0.23-0.29.

*Gyne* (description based on a single specimen). It differs from the worker in the following details: eyes about 1/5 of the head length. Ocelli well developed. Mandibles with 3 teeth before the apical tooth. Mesosoma robust and convex in side view. Scutellum large; its sides gently converging to a subconvex posterior border. Metanotum with a large spine. Each side of the basal face of the propodeum with a broader spine. Median dorsum of the basal face of the propodeum impressed and almost on the same plane as the declivous face. Lower half of the propodeal lobes truncate. Metapleural concavity deeper. Petiole as long as broad. Postpetiole about 1/3 shorter than gastral tergite I (LT4). Hind basitarsi about 1/5 shorter than hind tibiae.

Sculpture and pilosity as in the worker.

Colour. Dark ferrugineous-brown with lighter legs.

Measurements in mm and Indices: TL 5.66; HL 1.20; HW 1.18; EL 0.23; SL 0.81; WL 1.70; PeL 0.56; PeW 0.56; HFeL 1.18; HTiL 0.93; HBaL 0.75; LS4 0.26; LT4 1.14; CI 98.3; SI 67.5; IGR 0.23.

*Male* (Fig. 45) (tentative attribution). Head broader than long. Vertex in full face view convex and in posterior view flat. Vertexal margin medially carinate. Clypeus convex; its anterior border superficially crenulate on the sides and weakly notched medially. Frontal carinae thin, low, short, parallel and far from each other. Floor of the frontal carinae weakly impressed. Ocelli large. Compound eyes about half of the head length. Scapes not reaching the anterior border of the anterior ocellus. First funicular joint about 1/2 of the length of the second. Joints 2-11 longer than broad. Last

funicular joint slightly longer than the sum of joints 10-11. Mandibles as in *stictum*, edentate and only with a pointed apical tooth. Palp formula 4,3.

Mesosoma robust. Pronotum and anterior third of mesonotum almost perpendicular to the posterior two thirds of the mesonotum. Posterior two thirds of mesonotum nearly flat. Parapsidal furrows superficially marked. Scutellum as high as the mesonotum and dorso-medially with an impressed sulcus; posterior border of scutellum subround. Sides of the basal face of the propodeum with a triangular tooth separate from the other tooth by an incision. Declivous face of the propodeum flat and weakly marginate on the sides. Propleurae without incision. Metanotum with a median spine-like

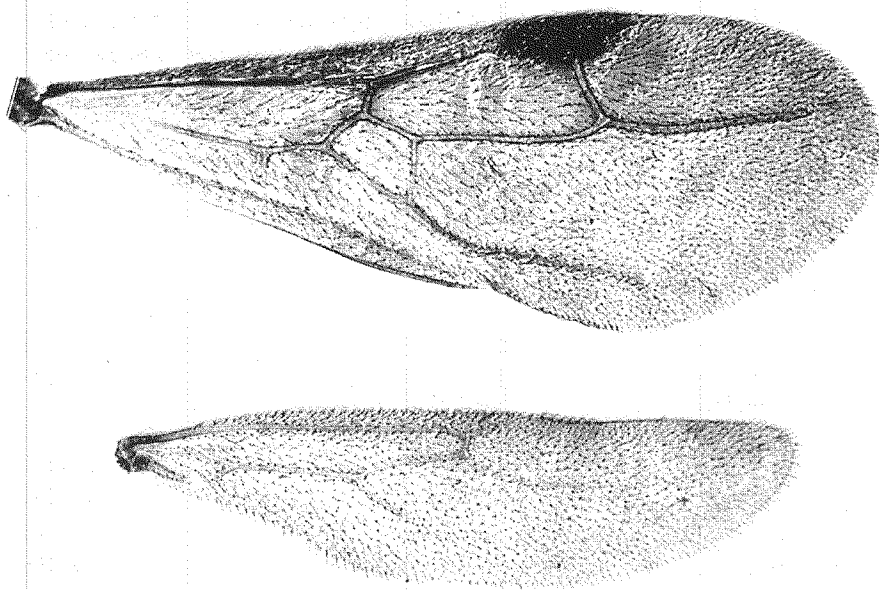


Fig. 46 – *Proceratium deelemani* Perrault. Male from Ulu Temburong, Brunei: fore and hind wings.

projection. Propodeal lobes subround, size similar to the one of *stictum* and smaller than in *foveolatum*. Propodeal spiracle well developed as in the holotype worker.

Petiole in side view convex, about 1/5 longer than broad. Sides of the petiole in dorsal view parallel on their anterior fifth and gently convex posteriorly. Anterior border of the petiole truncate, strongly carinate and with a denticle on each side. Subpetiolar process small and subround. Postpetiole anteriorly slightly broader than the petiole; postpetiolar sides diverging or gently convex posteriorly. Anterior border of the postpetiolar sternite with a Y-shaped carina. Posterior half of the postpetiolar sternite gently convex.

Gastral tergite I round. Gastral sternite I ventrally broader than in *foveolatum*. Remaining gastral tergites and sternites slightly curved ventrally.

Legs less stouter than in the worker.

Fore wings of our type 3, hind wings of our type 2 as defined in the description of the genus (Fig. 46).

Genitalia not dissected.

Sculpture. Head, mesosoma and petiole covered by dense, small, irregular foveae, slightly larger on the scutellum, more superficial on the mesopleurae; on some areas the foveae separate by thin, irregular rugosities. Anterior half of the postpetiolar dorsum with large piligerous foveae. Posterior half of the postpetiolar dorsum and postpetiolar sternite with sculpture similar to the one of the petiole. First gastral tergite with minute piligerous foveae; its posterior border with sculpture similar to the petiole. Legs with minute piligerous foveae.

Pilosity as in the worker but with the hair type (1) less dense on the scutellum, on the postpetiole and on the gaster, and hair type (2) shorter on the petiole and longer on the scutellum and on the gaster.

Colour. Black with shining postpetiole and gaster.

Measurements in mm and Indices: TL 4.37; HL 0.78; HW 0.90; EL 0.39; SL 0.34; WL 1.48; PeL 0.49; PeW 0.39; HFeL 0.98; HTiL 0.79; HBaL 0.61; LS4 0.33; LT4 0.88; CI 115.4; SI 43.6; IGR 0.37.

MATERIAL EXAMINED: BORNEO: KALIMANTAN TIMUR: Sepaku, 40 km NO of Balikpapan, 16.VII.1979, 1 worker (holotype), C. & R. Deeleman [MNHN]. BRUNEI: Ulu Temburong, Base camp hut, 300 m, 115°16' E 4°26' N, 16.I-9.III.1982, 1 male, M. C. Day [BMNH]. MALAYSIA: PAHANG: Cameron Highlands, 1520 m, Bukit Mentiga, 23.III.1993, 9 workers,

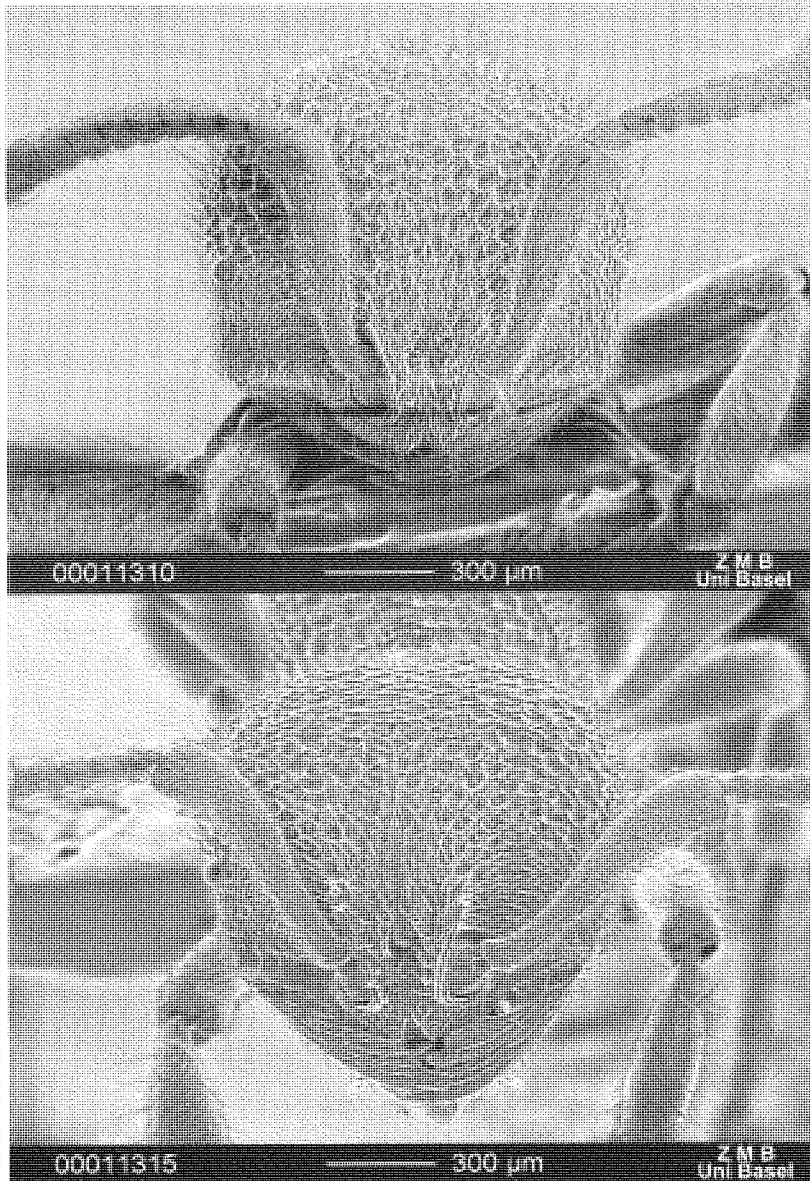


Fig. 47 – *Proceratium deelemani* Perrault. Worker heads in dorsal view. Specimen from Cameron Highlands, W Malaysia (top) and specimen from Nakhon Ratchasima, Thailand (bottom).

1 gyne, Löbl & Calame [BMNH, MHNG]; Genting Highlands, Awana, 950 m, 4.IV.1993, 1 worker, Löbl & Calame [MHNG]. NEGERI SEMBILAN: Pasoh For. Res., XI.1994, litter sample, 1 worker, M. Brendel, K. Jackson & S. Lewis [BMNH]. SABAH: Tawau, Quoin Hill, 750 ft, 16-18.VI.1968, rainforest, 5 workers, 3 ergatoids, R. W. Taylor [ANIC]; Sepilok, Forest Reserve near Sandakan, 11-12.VI.1968, nest ex. rotten log rainforest, 4 workers, R. W. Taylor [ANIC]; Posing Hot Springs, 8.V.1987, 1 worker, I. Löbl [MHNG]. SARAWAK: 4<sup>th</sup> Division Gunung Mulu Natural Park, RGS Expedition, Long Pala, lowland rainforest on rotten log, 14.X.1977, 1 worker, B. Bolton [BMNH]. THAILAND: Nakhon Ratchasima Prov., Khao Yai Natural Park, Khao Khieo Rd. 1050 m, rot. wd., 10.IV.1981, 5 workers, I. Burikam & W. L. Brown [MCZC, BMNH]; Kaeng Krachan, 16 & 17.XI.1985, 6 workers, I. Löbl & D. Burckhardt [BMNH, MHNG]. SINGAPORE: near Selatar Reservoir, 21.V.1968, recently cleared rainforest area, 1 worker, R. W. Taylor [ANIC].

DISCUSSION. The most significant variation observed among the *deelemani* workers we studied are in the size of the propodeal spiracle: only in the worker from Posing Hot Springs it is as large as in the holotype. The specimens from Thailand have the head dorsum more rugulose and the foveae much more irregular than the holotype (Fig. 47); some specimens have the postpetiole with the sides diverging on the anterior half and convex on the posterior half and others have it entirely convex. We can not exclude that the collection of additional material may allow the separation of one or more additional species within what we presently regard as *deelemani*.

The attribution of the male from Brunei to *deelemani* needs confirmation. The male in question has propodeal spiracles as large as the holotype worker. What we regard as a single, variable species, *deelemani*, however, is, together with *foveolatum*, one of the two sole species and the commonest one of the *stictum* clade reported from Borneo so far.

DISTRIBUTION: Borneo, Brunei, Malaysia (Sabah and Sarawak), Thailand and Singapore.

**Proceratium foveolatum** de Andrade n. sp.

Fig. 48, 49, 50

TYPE MATERIAL: holotype worker from Sarawak labelled: "Sarawak, 4<sup>th</sup> Div. G. Mulu Nat. Pk., RGS Expd. Long Pala, lowl. rainf. leaf litter on log, 1.X.1977, B. Bolton", in BMNH.

DERIVATIO NOMINIS: *foveolatum* is a neologism derived from the Latin *fovea* (= small hole) and refers to the integumental sculpture of this species.

DIAGNOSIS. A *Proceratium* species differing from all the species of the *stictum* clade by the following combination of characters: gastral tergite I with a broad, strong angle on the curvature and by the head, mesosoma, petiole, postpetiole and gaster covered by foveae.

DESCRIPTION. *Worker* (Fig. 48). Head about as broad as long, narrower anteriorly than posteriorly. Vertex in full face view gently concave medially and in posterior view flat. Clypeus broad, convex, protruding anteriorly and surrounding the whole antennal insertions. Anteromedian margin of the clypeus with a notch. Frontal carinae very far from each other, strongly diverging posteriorly and not covering the antennal insertions. Frons deeply concave medially. Lateral expansions of the frontal carinae relatively broad and slightly raised. Genal carinae present, strongly marked, prolonging towards the hypostomal bridge and probably bounding an impressed gular area (not visible in the sole specimen available). A superficial sulcus between the genal carinae and the gular area. Eyes present, composed by a small but clear convex facet placed slightly below the mid-line of the head. Scapes thick, distally incrassate, and far short of the vertexal margin. First funicular joint as broad as long. Funicular joints 2-10 broader than long. Last funicular joint as long as the sum of joints 7-10. Mandibles with 3 denticles before the apical tooth. Palp formula probably 4,3.

Mesosoma slightly elongate, gently convex in side view. Promesonotal suture weakly impressed. Propodeal suture absent. Promesopleural and meso-metapleural sutures impressed on the ventral half only. Basal face of the propodeum slightly convex and declivous posteriorly. Declivous face of the propodeum gently concave and each side with a carinate sulcus. Propodeum with a pair of relatively long, broad spines between the basal and declivous faces. Propodeal lobes ventrally truncate and dorsally with a broad, round tooth protruding dorsally. Metapleurae impressed between the

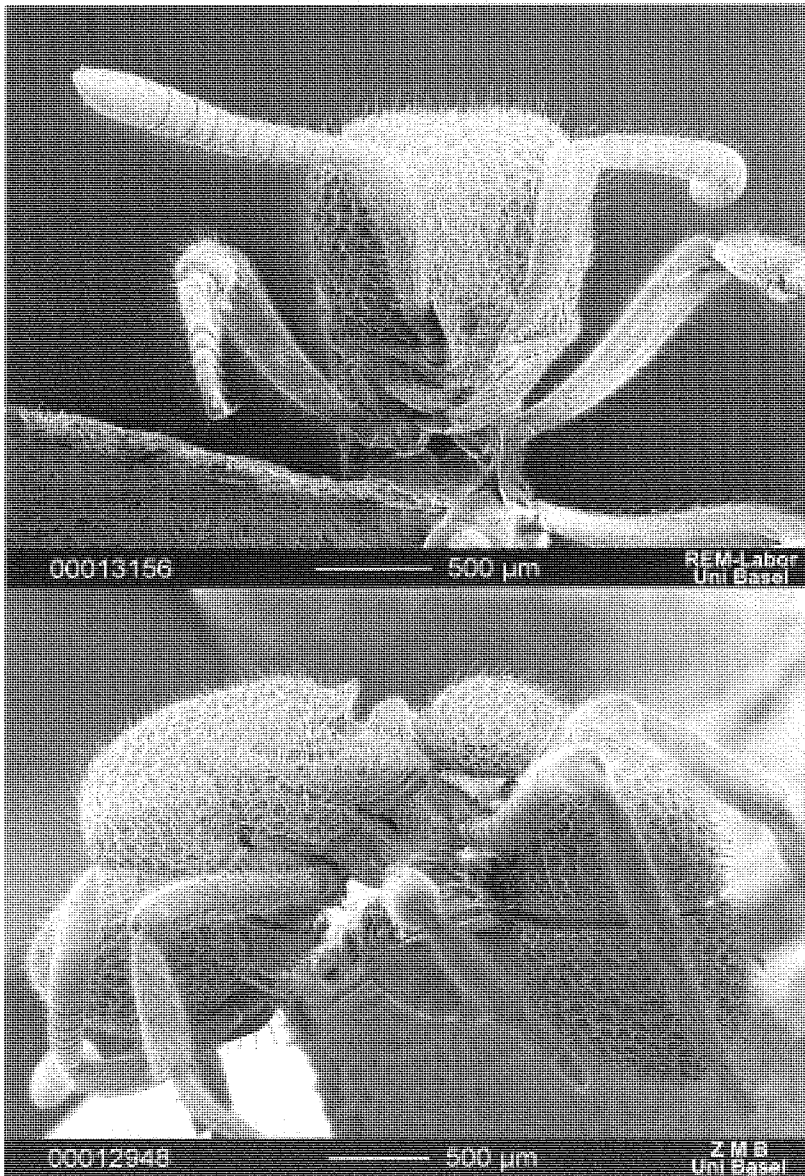


Fig. 48 – *Proceratium foveolatum* de Andrade. Worker (holotype) from 4<sup>th</sup> Division Gunung Mulu National Park, Long Pala, Sarawak: head (top) in dorsal view and meso- and metasoma (bottom) in side view.

propodeal spines and propodeal lobes, each impression sheltering the propodeal spiracle.

Petiole about 1/5 longer than broad, in dorsal view subparallel in the anterior fifth and convex posteriorly. Anterior border of the petiole straight, with a thick margin slightly denticulate on each side. Ventral process of the petiole absent. Postpetiole slightly shorter than gastral tergite I (LT4), with the sides diverging backwards in dorsal view. Postpetiolar sternite anteromedially with a marked subtriangular projection. Center of the postpetiolar sternite slightly convex. Constriction between postpetiole and gastral segment I impressed. Gastral tergite I with a strong, broad angle on the curvature and narrowing distally after the curvature. Gastral sternite I very short medially. Remaining gastral tergites and sternites slightly curved ventrally.

Legs elongate but with stout tibiae, basitarsi, tarsi and tarsomeres. All tibiae with a pectinate spur. Spurs of fore legs with a basal spine. Fore basitarsi slightly longer than the mid ones. Hind basitarsi about 1/4 shorter than hind tibiae. Second tarsomere of mid and hind legs longer than third and fourth tarsomeres, and shorter than pretarsus. Pretarsal claws simple. Arolia small.

Sculpture. Head, mesosoma, petiole, postpetiole and gaster densely covered by deep and relatively large, slightly irregular foveae. Interspaces between foveae granulopunctate. Bottom of the foveae smooth. Scapes and legs strongly granulate.

Body covered by hairs of three main types: (1) short, dense, subdecumbent on the whole body, suberect and sparse on the funicular joints; (2) suberect, long, thick on the whole body, absent from the antennae; (3) shorter than hair type (1), dense, decumbent or appressed on the funicular joints only. In addition the funicular joints bear whitish, thick, appressed, short, sparse hairs and the scapes bear sparse hairs shorter than hair type (2).

Colour dark brown to black with lighter antennae and legs.

Measurements in mm and Indices: TL 5.52; HL 1.18; HW 1.18; EL 0.06; SL 0.86; WL 1.64; PeL 0.68; PeW 0.53; HFeL 1.18; HTiL 0.96; HBaL 0.70; LS4 0.22; LT4 0.96; CI 100.0; SI 72.0; IGR 0.23.

*Male* (Fig. 49) (tentative attribution). Head broader than long. Vertex



flat in full face and in posterior view. Vertexal margin medially concave and with a relatively broad carina. Clypeus anteromedially with a triangular projection. Frontal carinae thin, higher than in *avioide* and *goliath*, parallel and far from each other. Frontal area deeply concave anteriorly. Ocelli large. Compound eyes very large, strongly convex and largely on the anterior half of the head sides. Scapes not reaching the anterior ocellus. First funicular joint about 1/3 shorter than the second joint. Joints 2-10 longer than broad and slightly shorter than the subapical joint. Apical joint as long as the sum of joints 10-11. Mandibles short, with blades narrower than in *stictum* and *deelemani*, edentate, only with a pointed apical tooth. Palp formula probably 4,3.

Mesosoma robust. Pronotum and anterior third of mesonotum almost perpendicular to the posterior two thirds of the mesonotum. Posterior two thirds of mesonotum almost flat. Parapsidal furrows superficially marked. Scutellum as high as the mesonotum; posterior border of scutellum sub-round. Sides of the basal face of the propodeum with a broad, triangular tooth separated each other by a deep incision. Declivous face of propodeum weakly marginate on the sides. Propleurae with a deep sulcus. Metanotum with a strong median spine-like projection. Propodeal lobes large and dorsally round.

Petiole about 1/3 longer than broad, with subparallel sides. Anterior border of the petiole truncate and with a small tooth on each side. Subpetiolar process absent. Postpetiole anteriorly slightly broader than the petiole; postpetiolar sides diverging posteriorly. Anterior border of the postpetiolar sternite carinate but not forming a triangular edge. Postpetiolar sternite with a posterior swelling.

Gastral tergite I making a strong, broad angle on the curvature and narrowing distally after the curvature. Gastral sternite I very short medially. Remaining gastral tergites and sternites curved ventrally.

Legs less stouter than in the worker. Arolia visible and small.

Fore wings of our type 2, hind wings of our type 1 as defined in the description of the genus (Fig. 50).

Genitalia not dissected.

Sculpture. Head, mesosoma, petiole, postpetiole and gaster foveolate-granulate, the foveae with irregular border, smaller on the frons and on the center of the pronotum, larger on the scutellum. Scapes and legs granulate, the granules more superficial than in the worker.

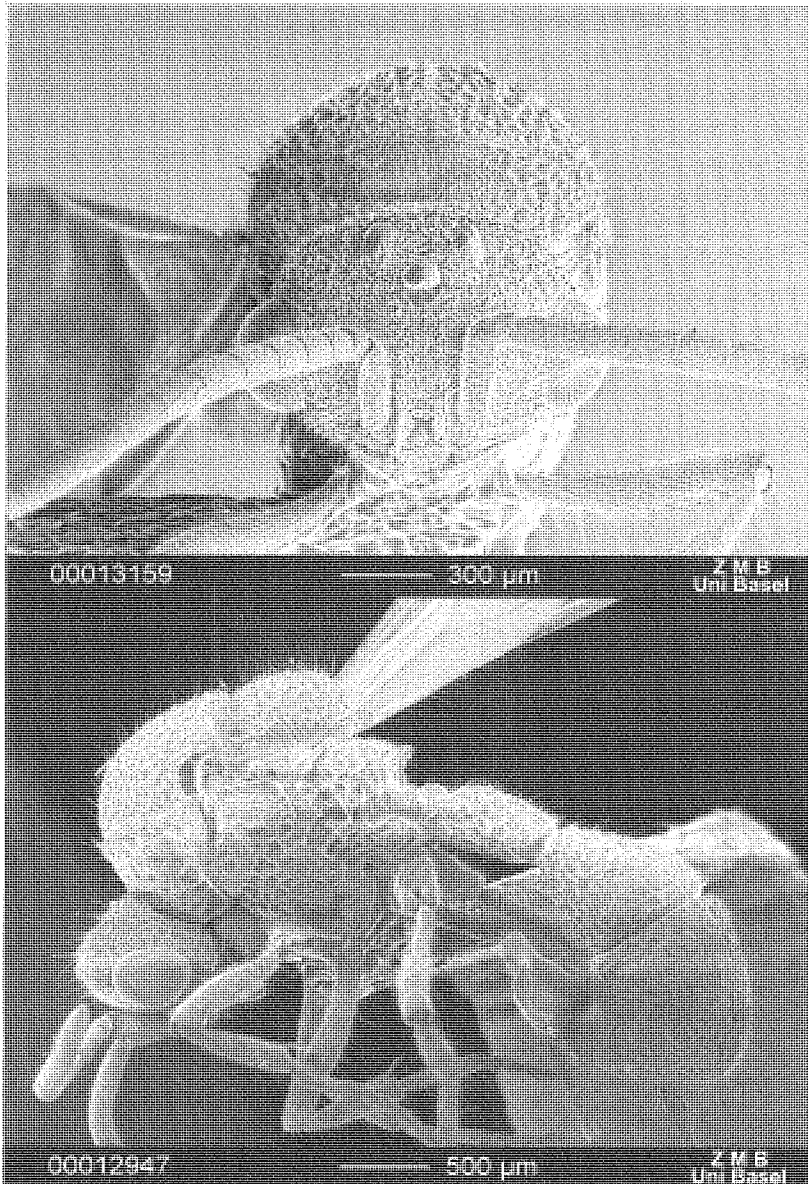


Fig. 49 – *Proceratium foveolatum* de Andrade. Male from Ulu Temburong, Brunei: head (top) in dorsal view and meso- and metasoma (bottom) in side view.

Pilosity as in the worker except for the hair type (2) which is longer on the scutellum and on the gaster.

Colour dark brown to black with funicular joints 2-12, coxae and femora lighter. Scapes, first funicular joint and remaining parts of the legs dark-orange ferrugineous

Measurements in mm and Indices: TL 4.98; HL 0.84; HW 0.93; EL 0.41; SL 0.40; WL 1.72; PeL 0.60; PeW 0.38; HFeL 1.07; HTiL 0.82; HBaL 0.66; LS4 0.22; LT4 0.92; CI 111.0; SI 47.6; IGR 0.24.

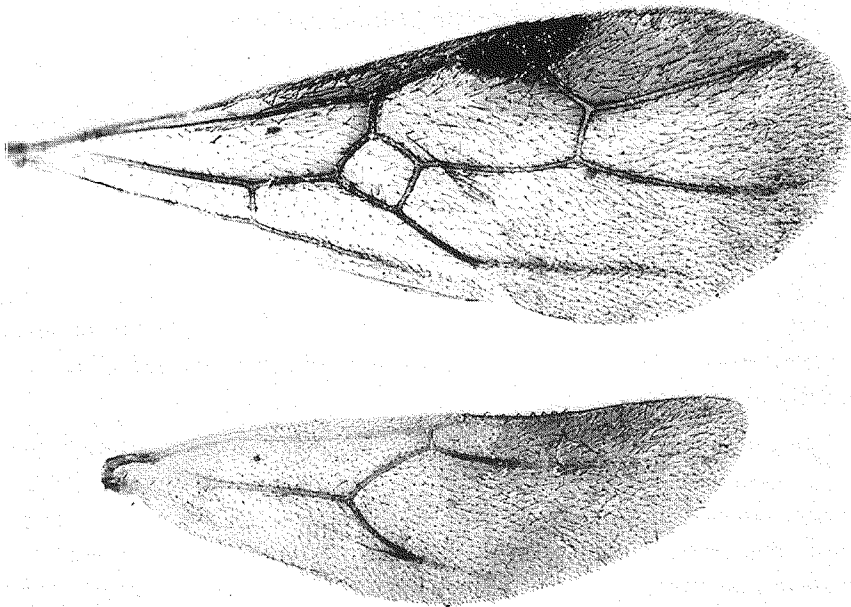


Fig. 50 – *Proceratium foveolatum* de Andrade. Male from Ulu Temburong, Brunei: fore and hind wings.

MATERIAL EXAMINED: MALAYSIA: SARAWAK: 4<sup>th</sup> Division Gunung Mulu National Park, RGS Expedition, Long Pala, lowland rainforest, leaf litter on log, 1.X.1977, 1 worker (holotype), B. Bolton [BMNH]. BRUNEI: Ulu Temburong, Base camp hut, 300 m, 115° 16' E 4°26' N, 16.I-9-III.1982, 1 male, M. C. Day [BMNH].

DISCUSSION. *Foveolatum* is a distinctive species within the *stictum* clade for its shape of the gaster and for the sculpture. We tentatively attribute the male from Ulu Temburong to *foveolatum* because of similarities with the holotype worker in pilosity and sculpture and because of their sharing the angle on the curvature of the gaster.

DISTRIBUTION: Malaysia (Sarawak), Brunei.

### ***Proceratium tio* Snelling & Cover**

#### Fig. 51

*Proceratium tio* Snelling & Cover, 1992: 50, fig. 1. Worker. Original description. Type locality: Veracruz, Mexico. Type material: a worker labelled: "Mex: Vera Cruz, 6 mi NE Catemaco, VII.7.1976, elev. 1500', A. Newton, Berl. Rainforest leaf litter, Holotype", in MCZC, examined.

DIAGNOSIS. A *Proceratium* species belonging to the *stictum* clade and to the *goliath* group, and differing from its sister species *goliath*, in the worker, by the following combination of characters: propodeal teeth larger, ventral process of the petiole distinct and spiniform instead of at most shortly triangular.

DESCRIPTION. *Worker* (Fig. 51). Head slightly longer than broad, with sides gently diverging posteriorly. Vertex convex in full face view. Clypeus broad, convex, protruding anteriorly and surrounding the whole antennal insertions. Anteromedian margin of the clypeus with a notch. Frontal carinae very far from each other, strongly diverging posteriorly and not covering the antennal insertions. Lateral expansions of the frontal carinae broad and slightly raised. Frons concave medially. Genal carinae marked. Head ventrally with a pair of superficially impressed longitudinal sulci delimited

externally by the genal carinae. Gular area deeply impressed. Eyes composed by a clear, convex facet, and placed slightly below the mid-line of the head. Scapes not reaching the vertexal border. First funicular joint about 1/5 longer than broad. Funicular joints 2-10 broader than long. Last funicular joint as long as the sum of joints 7-10. Mandibles with 3-4 denticles before the apical tooth. Palp formula 4,3.

Mesosoma convex in side view and slightly longer than the head (mandibles included). Promesonotal and propodeal sutures very weakly impressed. Promesopleural and meso-metapleural sutures impressed on the ventral half only. Basal face of the propodeum declivous posteriorly. Declivous face of the propodeum flat; sides of the declivous face carinate. Each side between the basal and declivous faces of the propodeum separate by a broad, subround, carinate tooth. Propodeal lobes subtruncate and apically convex. Propodeal spiracle tumuliform and placed over mid height in lateral view.

Petiole slightly longer than broad, with the sides diverging on the anterior third and convex posteriorly in dorsal view. Anterior border of the petiole gently concave and strongly carinate. Ventral process of the petiole spiniform. Postpetiole slightly shorter than gastral tergite I (LT4), with a broad tumulus close to the center of the posterior border in side view. Postpetiolar sternite anteromedially with a marked subtriangular projection. Posterior half of the postpetiolar sternite convex. Constriction between postpetiole and gastral segment I impressed. Gastral tergite I strongly convex. Remaining gastral tergites and sternites slightly curved ventrally.

Legs slender. All tibiae with a pectinate spur. Spurs of fore legs with a basal spine. Fore basitarsi slightly longer than the mid ones. Hind basitarsi about 1/5 shorter than hind tibiae. Second tarsomere of mid and hind legs longer than each, third and fourth tarsomeres, and slightly shorter than pretarsus. Pretarsal claws simple. Arolia present but small.

Sculpture. Head, mesosoma, petiole and postpetiole irregularly foveolate-punctate. Gaster smooth and with sparse, minute piligerous punctures. Legs with dense piligerous punctures.

Body covered by hairs of three main types: (1) short, dense, subdecumbent on the whole body, suberect and sparse on the funicular joints; (2) long, suberect or subdecumbent, relatively dense on the whole body, absent on the scapes and funicular joints; (3) shorter than hair type (1), dense and

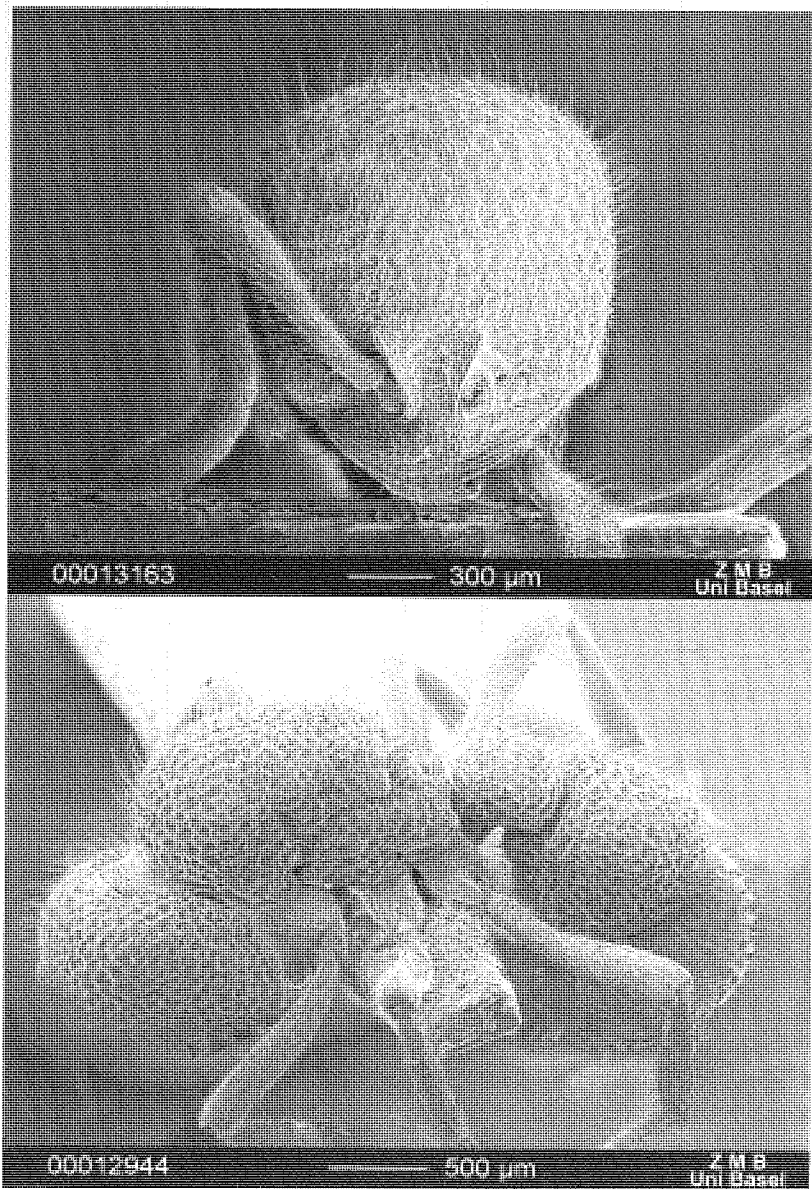


Fig. 51 – *Proceratium tio* Snelling & Cover. Worker from Mexico (no further locality): head (top) in dorsal view and meso- and metasoma (bottom) in side view.

decumbent on the funicular joints only. In addition, the funicular joints bear thick, appressed, short, sparse hairs and the scapes sparse, subdecumbent hairs slightly shorter than hair type (2).

Colour brownish-red, antennae and legs lighter.

Measurements in mm and Indices (specimen from CPCC): TL 5.30; HL 1.25; HW 1.17; EL 0.08; SL 0.87; WL 1.52; PeL 0.60; PeW 0.54; HFeL 1.16; HTiL 0.94; HBaL 0.74; LS4 0.14; LT4 0.92; CI 93.6; SI 70.2; IGR 0.15.

MATERIAL EXAMINED: MEXICO: no further locality, 1 worker, P. Jaisson [CPCC]. VERACRUZ: Veracruz, 6 mi NE Catemaco, 1500 ft. elev., 7.VII.1976, rainforest, leaf litter, 1 worker (holotype), A. Newton [MCZC].

DISCUSSION. As already noticed by Snelling & Cover (1992), *tio* is very similar to *goliath*. In our analysis *tio* is the sister species of *goliath* and both share by synapomorphy the worker  $HL \geq 1.25$  mm. *Tio* and *goliath*, in addition, share relatively low values of IGR (0.13-0.18) as compared to the other species of the *goliath* group (IGR 0.23-0.29). There are two other characters shared by *tio* and *goliath*, the loss of propodeal spines and lobes. We did not consider the propodeal spines in our data matrix because they appear to be rather variable (for instance *stictum* may have long and short spines). The propodeal lobes, included in our analysis, do not permit a clear synapomorphy hypothesis since they equally vary among other species of the clade.

DISTRIBUTION: Mexico.

### ***Proceratium goliath* Kempf & Brown**

Figs. 52, 53, 54, 55

*Proceratium goliath* Kempf & Brown, 1968: 94, figs. 1 & 2. Worker. Original description. Type locality: Costa Rica. Type material: five workers (holotype and paratypes) labelled: "R. Toro Amarillo, vic. Guapiles, Costa Rica, 25 Feb.- 9 March 1966, W. L. Brown", holotype in MCZC, paratypes in MCZC and MZSP, all examined.

DIAGNOSIS. A *Proceratium* species belonging to the *stictum* clade and to the *goliath* group, and differing from its sister species *tio*, in the worker, by

the following two characters: propodeal teeth smaller, ventral process of the petiole at most shortly triangular instead of distinct and spiniform.

DESCRIPTION. *Worker* (Fig. 52). Head slightly longer than broad, with gently convex sides. Vertex convex in full face view. Clypeus broad, convex, protruding anteriorly and surrounding the whole antennal insertions. Anteromedian margin of the clypeus with a notch. Frontal carinae very far each other, strongly diverging posteriorly and not covering the antennal insertions. Lateral expansions of the frontal carinae broad, convex and slightly raised. Frons concave medially. Genal carinae marked. Head, ventrally, with a pair of superficially impressed longitudinal sulci delimited externally by the genal carinae. Gular area impressed. Eyes present, composed by clearly convex facet, and placed slightly below the mid-line of the head. Scapes not reaching the vertexal margin. Funicular joints 2-10 broader than long. Last funicular joint as long as the sum of joints 7-10. Mandibles with 3-4 denticles before the apical tooth. Palp formula 4,3.

Mesosoma convex in side view and slightly longer than the head (mandibles included). Promesonotal and propodeal sutures very weakly impressed. Promesopleural and meso-metapleural sutures impressed on the ventral half only. Basal face of the propodeum declivous posteriorly. Declivous face of the propodeum flat; sides of the declivous face carinate. Each side between basal and declivous faces of the propodeum separate by a broad, subtriangular angle. Propodeal lobes truncate and apically convex. Propodeal spiracle tumuliform and placed over mid height in lateral view.

Petiole slightly longer than broad, with the sides diverging anteriorly and convex posteriorly in dorsal view. Anterior border of the petiole gently concave and strongly carinate. Ventral process of the petiole small, subtriangular. Postpetiole  $1/4$  shorter than length of the gastral tergite I (LT4), with a broad tumulus close to the middle of the posterior border in side view. Postpetiolar sternite anteromedially with a marked subtriangular projection. Posterior half of the postpetiolar sternite convex. Constriction between postpetiole and gastral segment I impressed. Gastral tergite I strongly convex. Remaining gastral tergites and sternites slightly curved ventrally.

Legs slender. All tibiae with a pectinate spur. Spurs of the fore legs with a basal spine. Fore basitarsi slightly longer than the mid ones. Hind basitarsi about  $1/8$  shorter than hind tibiae. Second tarsomere of mid and hind



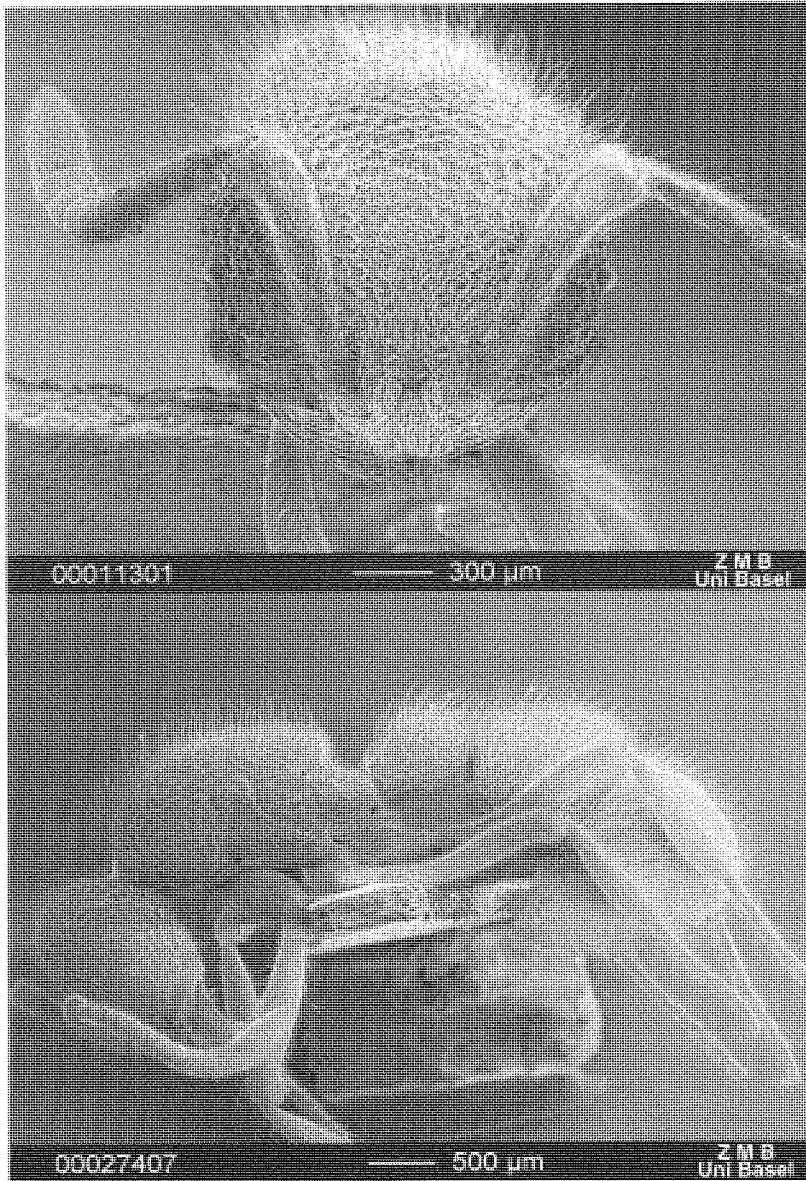


Fig. 52 – *Proceratium goliath* Kempf & Brown. Worker (paratype) from Río Toro Amarillo near Guapiles, Costa Rica: head (top) in dorsal view and meso- and metasoma (bottom) in side view.

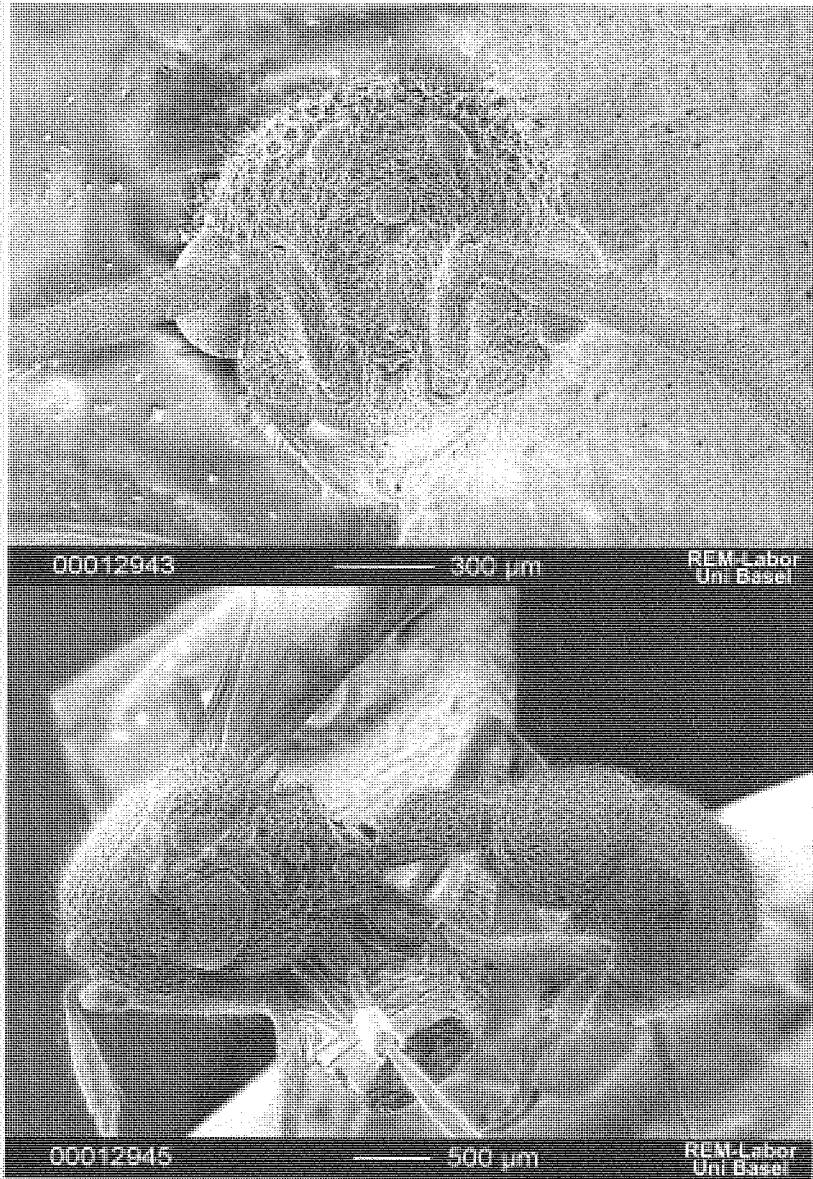


Fig. 53 – *Proceratium goliath* Kempf & Brown. Male from Zent, Costa Rica: head (top) in dorsal view and meso- and metasoma (bottom) in side view.

legs longer than the third and fourth tarsomeres, and slightly shorter than pretarsus. Fourth tarsomere of fore legs slightly longer than tarsomeres 1-3. Pretarsal claws simple. Arolia small but present.

Sculpture. Head, mesosoma, petiole and postpetiole irregularly foveolate-punctate and sparsely granulate. Gaster smooth and with, minute piligerous punctures. Legs with dense piligerous punctures.

Body covered by hairs of three main types: (1) short, dense, subdecumbent on the whole body, suberect and sparse on the funicular joints; (2) long, suberect or subdecumbent, relatively dense on the whole body, absent on the scapes and funicular joints; (3) shorter than hair type (1), dense and decumbent on the funicular joints only. In addition, the funicular joints bear thick, appressed, short, sparse hairs and the scapes sparse, subdecumbent hairs slightly shorter than hair type (2).

Colour brownish-red, legs lighter.

Measurements in mm and Indices: TL 6.22-6.72; HL 1.44-1.54; HW 1.36-1.44; EL 0.10; SL 1.04-1.12; WL 1.80-1.92; PeL 0.72-0.80; PeW 0.62-0.68; HFeL 1.44-1.52; HTiL 1.16-1.25; HBaL 1.02-1.10; LS4 0.17-0.24; LT4 1.16-1.32; CI 93.5-94.6; SI 70.3-72.2; IGR 0.15-0.18.

*Male* (tentative attribution, previously undescribed) (Fig. 53). Head about as long as broad. Vertex convex. Clypeus anteromedially gently convex and with a superficial notch on the anterior border. Frontal carinae little developed, parallel, not hiding the antennal socket and far each other. Space between the frontal carinae with a deep concavity on the center. Ocelli large. Compound eyes very large and on the anterior half of the head sides. Scapes at most reaching the anterior border of the anterior ocellus. First funicular joint about 1/2 of the length of the second joint; second joint slightly longer than joints 3-9, about as long as joints 10-11, and about half of the length of the last joint. Mandibles slender, edentate except for a swelling before the apical pointed tooth. Palp formula probably 4,3.

Mesosoma robust. In profile pronotum perpendicular, mesonotum gently convex, scutellum convex and higher than mesonotum. Mesonotum separated from the scutellum by a deep sulcus. Scutellum medially with a deep, longitudinal sulcus. Metanotum with a thick, median spine. Propodeum with differentiate basal and declivous faces. Basal and declivous faces separated laterally by an angle. Basal face medially with a deep sulcus prolonging up

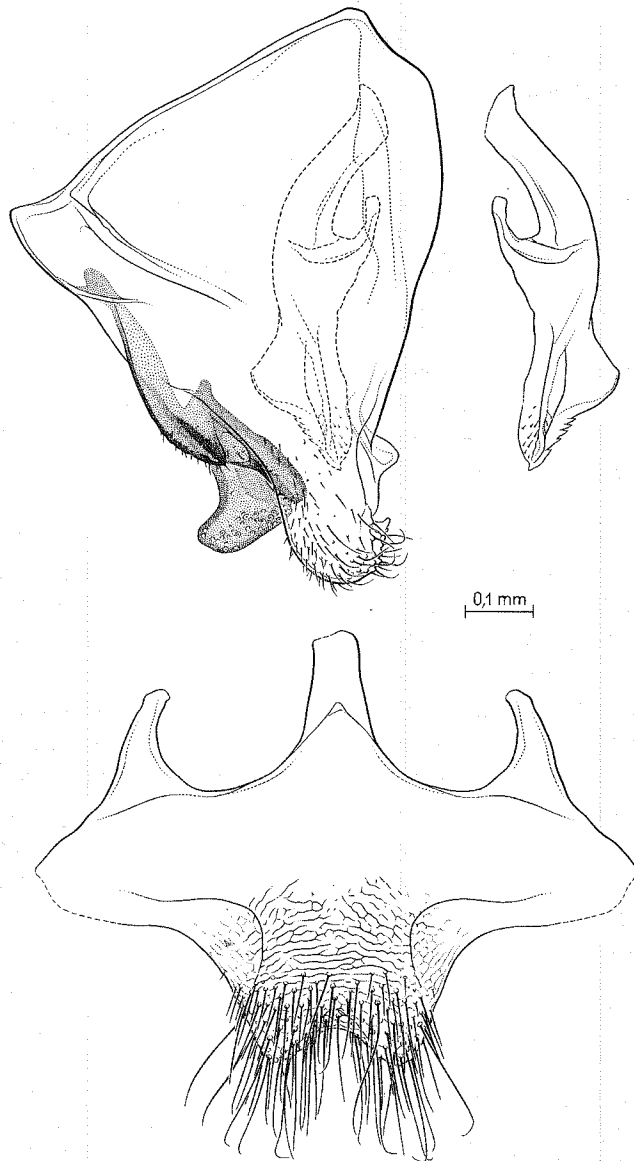


Fig. 54 – *Proceratium goliath* Kempf & Brown. Male from 16 km SSE of La Virgen, Prov. Heredia, Costa Rica. Genital appendages: a) lateral view of left parameres and of their relative positions; b) right aedeagus in profile; c) subgenital plate in ventral view.

to the anterior third of the declivous face. Declivous face anteriorly higher than posteriorly. Posterior part of the declivous face with carinate sides.

Petiole elongate, about 1/5 longer than broad, little convex dorsally. Anterior border of the petiole carinate and gently concave medially. Subpetiolar process absent but with a longitudinal carina. Postpetiole with the sides broadening posteriorly in dorsal view. Postpetiolar sternite anteromedially with a marked triangular carina.

Gastral tergite I strongly convex. Remaining gastral tergites and sternites curved ventrally.

Genitalia as in Fig. 54.

Legs long and slender. Hind tibiae slightly longer than the hind basitarsi. Fore basitarsi shorter than mid basitarsi.

Fore wings of our type 5, hind wings of our type 2 as defined in the description of the genus (Fig. 55).

Sculpture. Head, mesosoma, petiole and postpetiole irregularly foveolate-punctate, the foveae sparser on the mesopleurae, larger on the meta-pleurae. Propodeal dorsum with additional irregular rugosities. Gastral tergite I with similar sculpture as on the postpetiole but the foveae more superficial and absent on the sides. Legs smooth, tibiae and tarsi strongly punctate, the punctures denser on the tarsi.

Body covered by hairs of three main types: (1) short, dense, subdecumbent on the whole body, suberect and very sparse on the funicular joints; (2) long, suberect or subdecumbent, relatively dense on the whole body, absent on the scapes and funicular joints; (3) shorter than hair type (1), dense and decumbent on the funicular joints only. In addition, the funicular joints bear thick, appressed, short, sparse hairs and the scapes sparse, subdecumbent hairs shorter than hair type (2).

Colour. Dark brown-red with lighter legs.

Measurements in mm and Indices: TL 5.73-5.95; HL 0.98; HW 1.00-1.04; EL 0.40-0.42; SL 0.49-0.50; WL 1.96-2.10; PeL 0.62-0.67; PeW 0.49-0.50; HFeL 1.16-1.24; HTiL 1.12-1.24; HBaL 1.08-1.16; LS4 0.33-0.37; LT4 1.14-1.18; CI 102.0-106.1; SI 50.0-57.1; IGR 0.29-0.31.

MATERIAL EXAMINED: COSTA RICA: Río Toro Amarillo, vic. Guapiles, 25.I-9.III.1966, 1 worker (holotype) [MCZC], 4 workers (paratypes), W. L. Brown [MCZC, MZSP]; Zent, 17.VII.1956, 1 male, N. A. Weber [MCZC]; 16 km SSE La Virgen, 1050-1150 m, 10°16' N 84°05' W, 22.III.2001, 1

worker, INBio-OET-ALAS transect [INBC]; same locality, 9.III.2001, 1 male, INBio-OET-ALAS transect [INBC].

DISCUSSION. *P. goliath* is the largest species of the *stictum* group. Brown (1974) attributed a male from Zent, Costa Rica to *goliath*. We agree with Brown (l. c.) on this attribution since this Costarican male is slightly smaller than the *goliath* workers and the pilosity and sculpture resemble much that of the workers. In addition *goliath* is the sole species of the *stictum* clade reported from Costa Rica so far and the size of the Zent male is larger than the size of other males of the *goliath* clade as is the case for the workers. This hypothesis is confirmed by the collection in Costa Rica of another presumed *goliath* male that we recently received from Dr. Longino. According to Kempf & Brown (1968) the type series of *goliath* was collected in disturbed wet lowland rain forest under a fragment of rotten log.

DISTRIBUTION: Costa Rica.

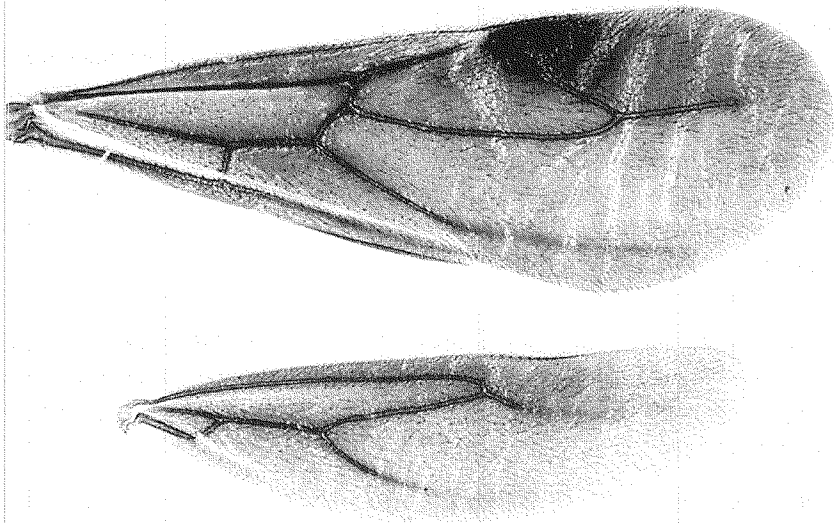


Fig. 55 – *Proceratium goliath* Kempf & Brown. Male from Zent, Costa Rica: fore and hind wings.

## THE *MICROMMATUM* CLADE

This clade includes 15 species: *brasiliense*, *catio*, *colombicum*, *convexiceps*, *cubanum*, *dominicanum*, *ecuadoriense*, *transitionis*, *poinari*, *lattkei*, *longiscapus*, *mexicanum*, *micrommatum*, *panamense* and *taino*. The species of the *micrommatum* clade are distributed from south Texas to south Brazil. The members of the clade share the following combination of synapomorphies: traces of a transversal propodeal sulcus in the worker, worker and gyne mid basitarsi with at least a hair long 1/2 or more of the basitarsus (this character seems to have been secondarily lost in 4 species, *cubanum*, *dominicanum*, *longiscapus* and *taino*), worker and gyne with first gastral tergite partially or entirely granulate, (this character is shared by the basal species of the *micrommatum* clade only), worker, gyne and male (when known) with palp formula 3,2.

*P. transitionis* appears in our analysis as the basalmost species of the *micrommatum* clade and *lattkei* results as the next in-group species of *transitionis*. *Transitionis* and *lattkei* are the most peculiar species of the clade. In fact both resemble in some characters the species of the *goliath* group by sharing with them the broad diverging frontal carinae and the dense and long pilosity. However, they share with all the remaining *Proceratium* species the mid legs with a spur, a character absent in all the other species of the *micrommatum* clade.

The other 13 species of the *micrommatum* clade are very similar each other and often difficult to differentiate. These species can be easily separated from the two basal species, *transitionis* and *lattkei*, by the lack of spurs on the mid legs and by the narrow, raised frontal carinae.

### ***Proceratium transitionis* de Andrade n. sp.**

Figs. 56, 57

TYPE MATERIAL: holotype worker from Colombia labelled: "Santander: Virolín, Costilla de Fara, 6°6'19"N 73°13'20"W, 1800 m, 29.III.1999, 1 worker (holotype), E. L. Gonzáles" in IAVH.

DERIVATIO NOMINIS: from the Latin *transitio* (Cicero), referred to the characters that this species shares with the *stictum* clade.

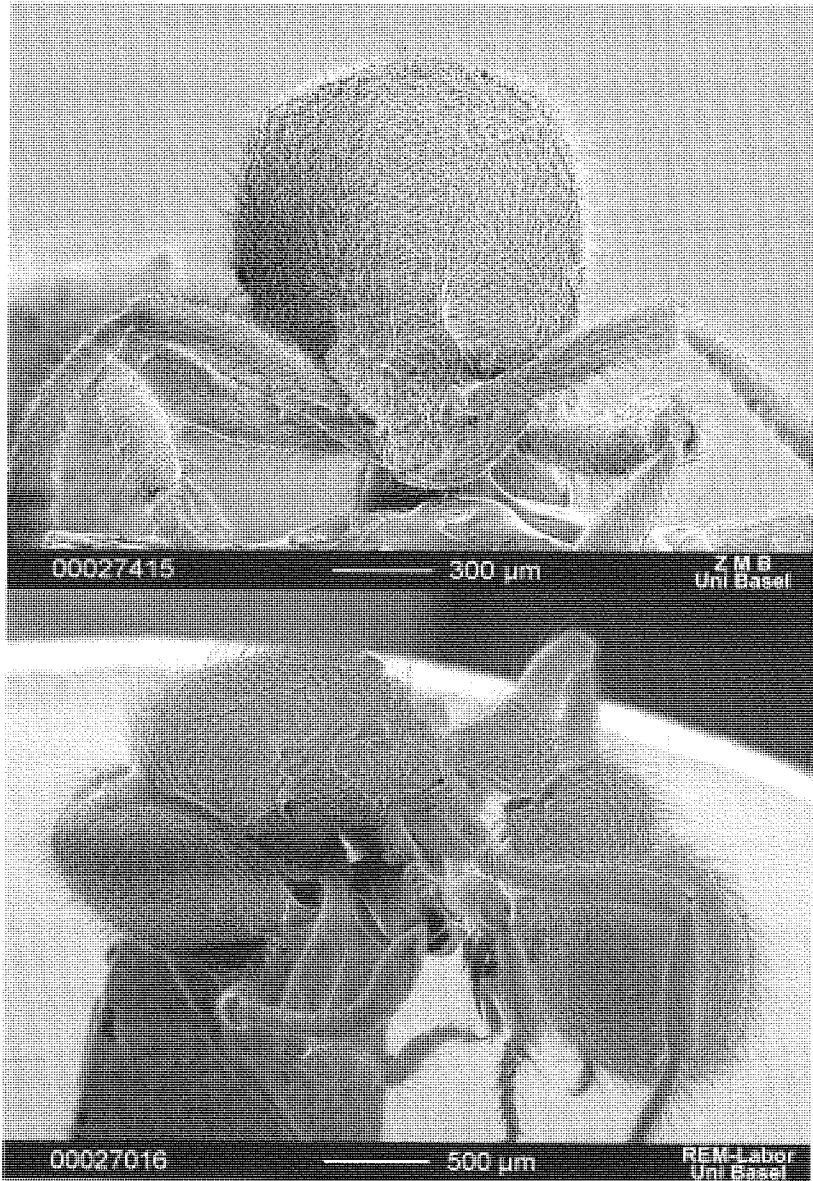


Fig. 56 – *Proceratium transitionis* de Andrade. Worker (holotype) from Virolín, Costilla de Fara, Colombia: head (top) in dorsal view and meso- and metasoma (bottom) in side view.



DIAGNOSIS. A *Proceratium* species appearing as basalmost of the *micrommatum* clade and differing from all the other species of this clade, by the worker clypeus broad and subrectangular instead of narrow, triangular or convex and by the petiole 1/4 longer than broad instead of at most 1/5 longer than broad; and from the next in-group species, *lattkei*, in the worker, by the propodeal dorsum with tumulus; and from all the other species of the *micrommatum* clade except *lattkei*, by the worker mid legs with a spur and by the broad, diverging frontal carinae.

DESCRIPTION. *Worker* (Figs. 56, 57). Head longer than broad and with the sides gently diverging posteriorly. Vertex in full face view slightly convex. Clypeus broad, subrectangular protruding anteriorly and narrowly surrounding the antennal insertion. Antennal socket with broad torulus. Frontal carinae broad, separate from each other, covering part of the antennal insertions. Floor of the frontal carinae with a central sulcus. Frontal area behind the frontal carinae gently convex. Lateral expansions of the frontal carinae relatively broad, slightly raised, strongly diverging on the two anterior thirds and parallel, low and marginate on the posterior third. Genal carinae marked, prolonging towards the hypostomal bridge and bounding a weakly concave gular area. A sulcus is present between the genal carinae and the gular area. Eyes present, composed by a convex facet placed below the midline of the head. Scapes thicker in their distal half and much shorter than the vertexal margin. First funicular joint slightly longer than broad. Funicular joints 2-10 broader than long. Last funicular joint as long as the sum of joints 6-10. Mandibles (only left visible) with 2 large teeth before the apical tooth. Palp formula 3,2.

Mesosoma slightly convex in profile. Promesonotal and propodeal sutures absent. Promesopleural and mesometapleural sutures impressed on the ventral half only. Basal face of the propodeum weakly convex and with a shining medial tumulus. Area behind the propodeal tumulus with a transversal, superficial impression. Sides between the propodeal basal and declivous faces unarmed. Declivous face of the propodeum with the posterior sides marginate. Ventral part of the propodeal lobes obtuse, dorsal part round and slightly crenulate.

Petiole 1/4 longer than broad, in dorsal view diverging in the anterior third and convex posteriorly. Anterior border of the petiole superficially carinate and medially concave. Ventral process of the petiole needle-

shaped. Postpetiole slightly less than 1/2 of the length of the gastral tergite I (LT4), in dorsal view with convex sides. Posterior half of the postpetiolar dorsum weakly convex in the middle. Postpetiolar sternite anteromedially with a marked subround border. Posterior half of the postpetiolar sternite gently convex. Constriction between postpetiole and gastral segment I deeply impressed. Gastral tergite I markedly round. Gastral sternite I (LS4) very short medially. Sides of gastral sternite I without carina. Remaining gastral tergites and sternites curved ventrally.

Legs slightly elongate. Mid tibiae with spur. Spurs of fore legs without a basal spine. Fore basitarsi longer than the mid ones. Hind basitarsi about 1/7 shorter than hind tibiae. Second tarsomere of mid and hind legs longer than each the third and fourth tarsomeres, and shorter than pretarsus. Pretarsal claws simple. Arolia very small.

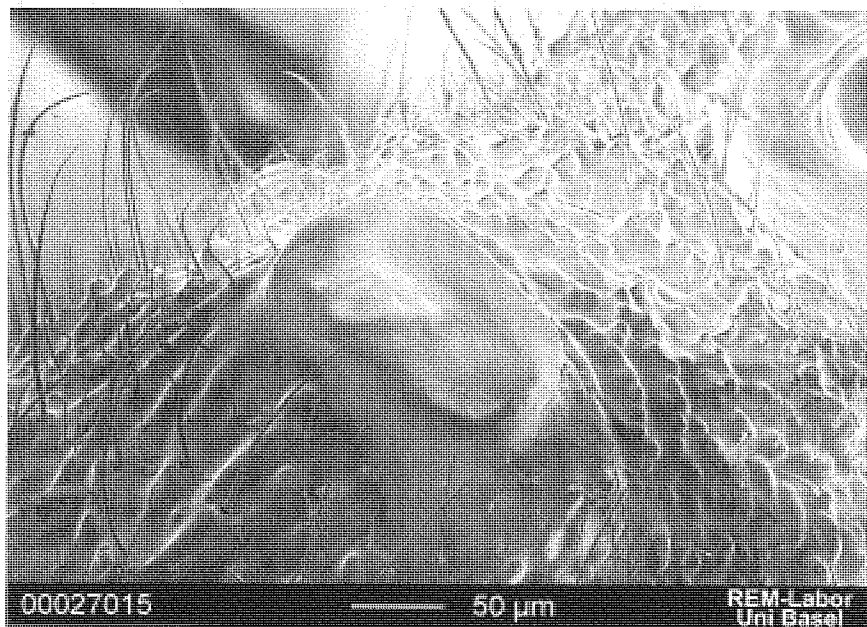


Fig. 57 – *Proceratium transitionis* de Andrade. Worker (holotype) from Virolín, Costilla de Fara, Colombia: propodeal tumulus.

Sculpture. Head granulate, sparsely and irregularly rugulose, the granulation larger posteriorly. Mesosoma, petiole and postpetiole irregularly granulate-foveolate, the foveae more superficial on the mesonotum, some granules raised as small peaks. Mesonotum, lower meso- and metapleurae with additional irregular rugosities. First gastral tergite granulate, the granulation denser on its sides and posteriorly. Legs and antennae superficially granulate-punctate.

Body covered by hairs of three main types: (1) short, dense, subdecumbent on the whole body, sparse and erect on the funicular joints; (2) long, suberect and relatively dense on the whole body, absent from the antennae; (3) shorter than hair type (1), dense, subdecumbent and appressed on the funicular joints only. In addition the funicular joints bear whitish, thick, appressed, short, sparse hairs, and the scapes with hairs similar to type (2) but shorter.

Colour dark ferruginous-brown with slightly lighter legs.

Measurements in mm and Indices: TL 5.00; HL 1.20; HW 1.04; EL 0.08; SL 0.72; WL 1.40; PeL 0.56; PeW 0.42; HFeL 1.04; HTiL 0.85; HBaL 0.64; LS4 0.20; LT4 1.16; CI 86.7; SI 60.0; IGR 0.17.

MATERIAL EXAMINED: COLOMBIA: SANTANDER: Virolín, Costilla de Fara, 6°6'19"N 73°13'20"W, 1800 m, 29.III.1999, 1 worker (holotype), E. L. González [IAVH].

DISCUSSION. *Transitionis* is a noteworthy species of the genus *Proceratium*. In our analysis it appears as the basalmost species of the *micrommatum* clade. It resembles nonetheless the species of the *stictum* clade by sharing with them the broad clypeus. Within the *micrommatum* clade, it shares with all the members of the *goliath* group the broad, diverging frontal carinae and the dense and long pilosity. *Transitionis* shares, however, with its next in-group species *lattkei* and with all the other species of the genus *Proceratium* the mid tibiae with spur, a character absent in all the other species of the *micrommatum* clade.

Of course *transitionis* differs from all the species of the *stictum* clade by missing the spine on the spur of the fore legs and by the palp formula 3,2 instead of 4,3.

DISTRIBUTION: Colombia.

**Proceratium lattkei** de Andrade n. sp.

Fig. 58

TYPE MATERIAL: holotype worker from Venezuela labelled: "Venez. Sucre, Cerro Humo vía Las Melenas, 950m, 9.7 km NW Irapa, 10°41' N-62°37' W, 12.V.1993, J. Lattke", in MIZA.

DERIVATIO NOMINIS: this species is named after John Lattke the collector of the material on which this species is based.

DIAGNOSIS. A *Proceratium* species differing from its outgroup species, *transitionis*, in the worker, by the clypeus narrow and triangular instead of broad and subrectangular and by the propodeal dorsum without tumulus; and differing from all the other in-group species of the *micrommatum* clade, in the worker, by the mid legs with spur and by the broad, diverging frontal carinae.

DESCRIPTION. *Worker* (Fig. 58). Head longer than broad and with slightly convex sides. Vertex in full face view convex. Clypeus corresponding to a triangular tooth between and slightly longer than the antennal sockets. Antennal socket with broad torulus. Frontal carinae broad, separate from each other, covering part of the antennal insertions. Frons with a central sulcus. Frontal area behind the frontal carinae almost flat. Lateral expansions of the frontal carinae relatively broad, slightly raised, strongly diverging on the two anterior thirds and parallel, low and marginate on the posterior third. Genal carinae marked, prolonging towards the hypostomal bridge and bounding a slightly concave gular area. A sulcus is present between the genal carinae and the gular area. Eyes present, composed by a clearly convex facet placed below the midline of the head. Ocelli absent. Scapes thicker in the distal half and well short of the vertexal margin. First funicular joint as broad as long. Funicular joints 2-10 broader than long. Last funicular joint as long as the sum of joints 7-10. Mandibles with 4 small teeth before the apical tooth. Palp formula probably 3,2.

Mesosoma in side view slightly convex. Promesonotal and propodeal sutures absent. Promesopleural and mesometapleural sutures impressed on the ventral half only. Basal face of the propodeum gently sloping posteriorly with traces of a transversal, superficial impression. The sides between basal and declivous propodeal faces angulate. Declivous face of the propodeum

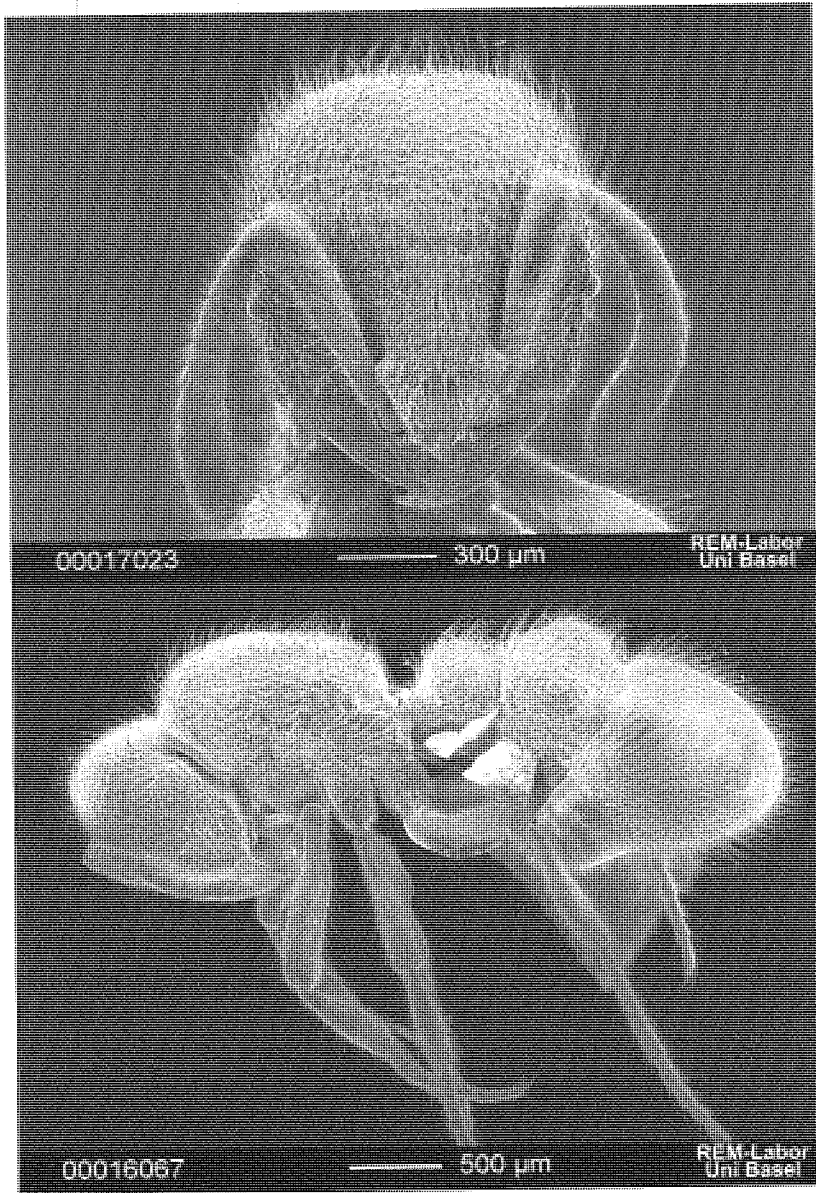


Fig. 58 – *Proceratium latkei* de Andrade. Worker (holotype) from Cerro Humo, via Las Melenas, Venezuela: head (top) in dorsal view and meso- and metasoma (bottom) in side view.

with the sides weakly crenulate. Ventral part of the propodeal lobes truncate, dorsal part with a round tooth with crenulate border.

Petiole slightly longer than broad, subparallel in the anterior fourth and convex posteriorly in dorsal view. Anterior border of the petiole entirely carinate and medially concave. Ventral process of the petiole small and subtriangular. Postpetiole about 1/2 of the length of the gastral tergite I (LT4), with convex sides in dorsal view. Posterior half of the postpetiolar dorsum with a broad, short tumulus in the middle. Postpetiolar sternite anteromedially with a marked subtriangular border. Posterior half of the postpetiolar sternite weakly convex. Constriction between postpetiole and gastral segment I deeply impressed. Gastral tergite I strongly rounded. Gastral sternite I (LS4) very short medially. Sides of gastral sternite I carinate. Remaining gastral tergites and sternites curved ventrally.

Legs slightly elongate. Mid tibiae with spur. Spurs of fore legs without a basal spine. Fore basitarsi longer than the mid ones. Hind basitarsi about 1/7 shorter than hind tibiae. Second tarsomere of mid and hind legs longer than third and fourth tarsomeres, and shorter than pretarsus. Pretarsal claws simple. Arolia very small.

Sculpture. Head, mesosoma, petiole and postpetiole irregularly reticulate-foveolate and granulate, some granules raised as small peaks. Lower meso- and metapleurae with irregular, longitudinal rugosities. Antero-dorsal half of the gaster smooth and sparsely granulate, densely reticulate-granulate on the remaining parts. Legs and antennae superficially granulate-punctate.

Body covered by hairs of three main types: (1) short, dense, subdecumbent on the whole body, sparse and erect on the funicular joints; (2) long, suberect and relatively dense on the whole body, absent from the antennae; (3) shorter than hair type (1), dense, subdecumbent and appressed on the funicular joints only. In addition the funicular joints bear whitish, thick, appressed, short, sparse hairs, and the scapes with hairs similar to type (2) but shorter.

Colour dark ferruginous-brown with slightly lighter legs.

Measurements in mm and Indices: TL 4.82; HL 1.12; HW 1.02; EL 0.08; SL 0.69; WL 1.30; PeL 0.51; PeW 0.45; HFeL 1.00; HTiL 0.78; HBaL 0.67; LS4 0.21; LT4 1.10; CI 91.1; SI 61.6; IGR 0.19.

MATERIAL EXAMINED: VENEZUELA: SUCRE: Cerro Humo, Las Mele-  
nas, 950 m, 9.7 km NW Irapa, 10°41' N, 62°37' W, 10.V.1993, 1 worker  
(holotype), J. Lattke [MIZA].

DISCUSSION. *Lattkei* is another noteworthy species of the genus *Proce-  
ratium*. Within the *micrommatum* clade it resembles its outgroup *transition-  
is* and also the members of the *goliath* group (*stictum* clade) by sharing  
with them the broad frontal carinae and the dense, long pilosity. *Lattkei* dif-  
fers from *transitionis* and the members of the *stictum* clade by the clypeus  
reduced and triangular instead of broad and strongly protruding anteriorly.  
*Lattkei* also differs from the other members of the *stictum* clade by the spur  
of the fore legs without a basal spine and by the palp formula 3,2 instead  
of 4,3.

DISTRIBUTION: Venezuela.

### ***Proceratium ecuadoriense* de Andrade n. sp.**

Fig. 59

?*Proceratium micrommatum* (Roger), Brown, 1980: 343. Misidentification.

?*Proceratium micrommatum* Roger, Ward, 1988: 117. Misidentification.

TYPE MATERIAL: holotype worker from Ecuador labelled: "Prov. Pichincha, S. & J. Peck,  
1975, Tinalandia, 16 km SE S. Domingo de los Colorados, Jun, 680 m"; one paratype worker,  
same data as the holotype, both in MCZC.

DERIVATIO NOMINIS: "*ecuadoriense*" is a neologism indicating the prove-  
nance of this species from Ecuador.

DIAGNOSIS. A *Proceratium* species appearing as the basal species of a  
small clade containing three additional species: *brasiliense*, *catio* and  
*colombicum*, but differing from these three species by the following two  
worker characters: broader and lower propodeal tumulus and deeper integu-  
mental sculpture (see the figures accompanying the relative species descrip-  
tions).

DESCRIPTION. *Worker* (Fig. 59). Head longer than broad, slightly nar-  
rower anteriorly than posteriorly. Vertex in full face view convex. Clypeus

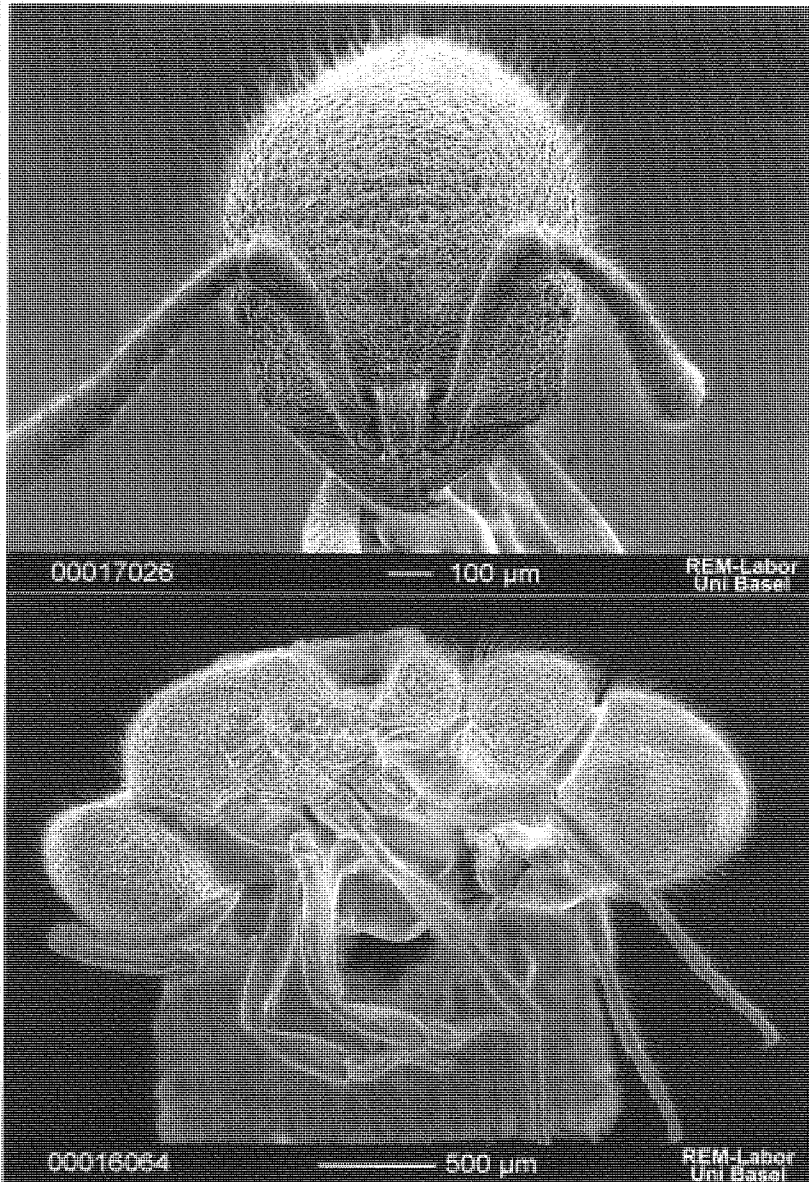


Fig. 59 – *Proceratium ecuadoriense* de Andrade. Worker (holotype) from Tinalandia, Pichincha, Ecuador: head (top) in dorsal view and meso- and metasoma (bottom) in side view.



corresponding to a small triangular tooth between and slightly longer than the antennal socket. Antennal socket with broad torulus. Frontal carinae close to each other, not covering the antennal insertions. Frontal area behind the frontal carinae weakly convex. Lateral expansions of the frontal carinae relatively narrow, raised, subparallel. Genal carinae present, marked, prolonging towards the hypostomal bridge and bounding a superficially smooth gular area. A superficial sulcus is present between the genal carinae and the gular area. Eyes present, composed by a clearly convex facet below the head midline. Scapes thicker in the distal half and far short of the vertexal margin. First funicular joint  $1/3$  longer than broad. Funicular joints 2-10 broader than long. Last funicular joint as long as the sum of joints 6-10. Mandibles with 3-4 denticles before the apical tooth. Palp formula apparently 3,2.

Mesosoma slightly convex in profile. Promesonotal and propodeal sutures absent. Promesopleural and mesometapleural sutures impressed on the ventral half only. Basal face of the propodeum with a broad, short, tumulus medially; area behind the propodeal tumulus with a superficial transversal sulcus. Declivous face of the propodeum flat; its sides with a superficial margin. Propodeal lobes ventrally truncate and dorsally with a subround, narrow crenulate margin. Propodeal spiracles small and tumuliform.

Petiole slightly longer than broad, subparallel in the anterior fourth and convex posteriorly in dorsal view. Anterior border of the petiole entirely carinate and only angulate on each side. Ventral process lamelliform and triangular. Postpetiole more than  $1/2$  of the length of the gastral tergite I (LT4), with convex sides in dorsal view. Postpetiolar sternite anteromedially with a marked subtriangular projection. Posterior half of the postpetiolar sternite slightly convex. Constriction between postpetiole and gastral segment I deeply impressed. Gaster tergite I convex dorsally and round on the curvature. Gaster sternite I (LS4) very short medially. Sides of gaster sternite I slightly protruding anteriorly, obtuse or round and carinate. Remaining gaster tergites and sternites curved ventrally.

Legs slightly elongate. Mid tibiae without spur. Spurs of fore legs without basal spine. Fore basitarsi longer than the mid ones. Hind basitarsi about  $1/5$  shorter than hind tibiae. Second tarsomere of mid and hind legs longer than third and fourth tarsomeres and slightly shorter than pretarsus. Pretarsal claws simple. Aroliia very small.

Sculpture. Head, mesosoma, petiole and postpetiole irregularly reticulate-foveolate and granulate, these sculptures less marked on the propodeal tumulus. The granules raised as small peaks on the petiole and postpetiole. Gaster densely granulate. Legs and antennae superficially granulate.

Body covered by hairs of three main types: (1) short, dense, subdecumbent on the whole body, sparse and erect on the funicular joints; (2) long, suberect and relatively dense on the whole body, absent from the tumulus of the basal face of the propodeum and on the antennae; (3) shorter than hair type (1), dense, subdecumbent and appressed on the funicular joints only. In addition the funicular joints bear whitish, thick, appressed, short, sparse hairs, and the scapes with sparse hairs similar to type (2) but shorter.

Colour ferrugineous with antennae and legs dark orange.

Measurements in mm and Indices: TL 3.21-3.62; HL 0.76-0.88; HW 0.69-0.80; EL 0.04-0.07; SL 0.49-0.55; WL 0.90-1.02; PeL 0.32-0.37; PeW 0.28-0.34; HFeL 0.61-0.70; HTiL 0.51-0.59; HBaL 0.38-0.45; LS4 0.15-0.18; LT4 0.68-0.79; CI 90.8-90.9; SI 62.1-64.5; IGR 0.22-0.23.

MATERIAL EXAMINED: ECUADOR: Río Palenque, Univ. Miami Res. Station, 29.VII.1978, 1 worker, G. J. Umphrey [MCZC]. PICHINCHA: Tinalandia, 16 km SE Santo Domingo de los Colorados, 680 m, VI.1975, 2 workers (holotype and paratype), S. & J. Peck [MCZC]; Tinalandia, 12 km E Santo Domingo de los Colorados, 11-17.V.1986, 2500', litter, 1 worker, G. B. Edwards [FSCA].

DISCUSSION. *P. ecuadoriense* can be easily distinguished from the other species of the *micrommatum* clade by the combination of characters already mentioned in the diagnosis. The identification keys by BROWN (1980) and by WARD (1988) record the presence of "*micrommatum*" in Ecuador without explicitly referring to the material on which the record is based. All the Ecuadorian specimens of the *micrommatum* clade we saw belong unequivocally to *ecuadoriense*. In addition, our records for *ecuadoriense* are probably drawn on the same material as those resulting from the previous literature, at least in part. For this reason we tentatively list as synonyms of *ecuadoriense* these previous literature records.

DISTRIBUTION: Ecuador.

***Proceratium colombicum*** de Andrade n. sp.

Figs. 60, 61

TYPE MATERIAL: holotype worker (unique) from Colombia labelled: "Nariño, Orito, Territorio Kofan, 00° 30' N 77° 13' W, 1000 m, 25.IX.1998, E. L. Gonzáles", in IAVH.

DERIVATIO NOMINIS: "*colombicum*" is a neologism indicating the provenance of this species from Colombia.

DIAGNOSIS. A *Proceratium* species appearing as basal to *brasiliense* and *catio* and differing from both, in the worker, by the following set of characters: head, mesosoma, petiole and postpetiole covered by dense granulation instead of granulate-rugulose foveolate, and first gastral tergite entirely densely granulate instead of densely granulate after the curvature only.

DESCRIPTION. *Worker* (Figs. 60, 61). Head longer than broad; its sides slightly narrower anteriorly than posteriorly. Vertex in full face view convex. Clypeus recognizable as a small triangular or subtriangular tooth between the antennal sockets. Frontal carinae close to each other, not covering the antennal insertions. Frontal area behind the frontal carinae weakly convex. Lateral expansions of the frontal carinae relatively narrow, raised and diverging posteriorly. Genal carinae strongly marked. Sulcus between the genal carinae and the gular area impressed. Eyes present, composed by a clearly convex facet slightly below the midline of the head. Ocelli absent. Scapes thicker in the distal half and far short of the vertexal margin. First funicular joint 1/3 longer than broad. Funicular joints 2-10 broader than long. Last funicular joint as long as the sum of joints 7-10. Mandibles with 3 denticles before the apical tooth. Palp formula 3,2.

Mesosoma slightly elongate. Promesopleural and mesometapleural sutures impressed on the ventral half only. Basal face of the propodeum with a semitransparent tumulus medially; area behind the propodeal tumulus short, and resembling a transversal sulcus, the sulcus more concave medially and postero-laterally carinate. Declivous face of the propodeum flat, its sides crenulate and sub-convex close to the propodeal lobes. Propodeal lobes truncate. Propodeal spiracles tumuliform.

Petiole slightly longer than broad, with the sides subparallel in the anterior third and convex posteriorly in dorsal view. Anterior border of the peti-

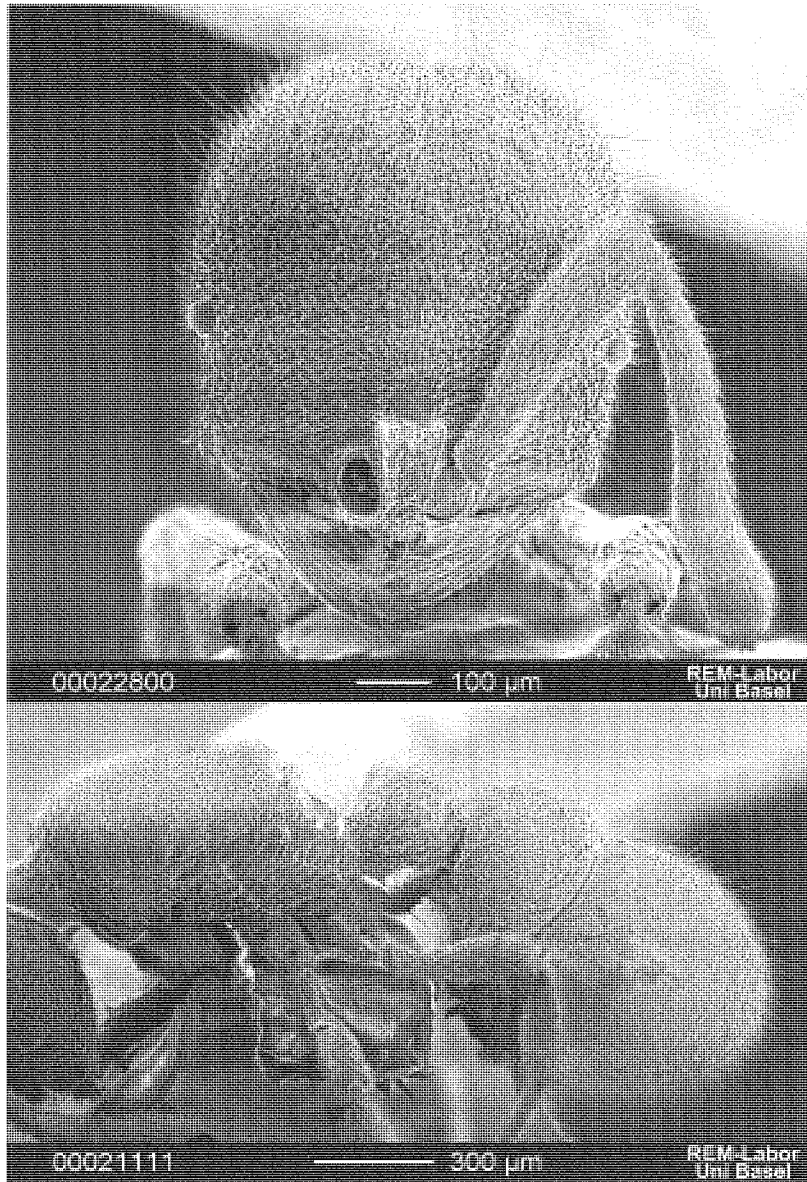


Fig. 60 – *Proceratium colombicum* de Andrade. Worker (holotype) from Orito, Nariño, Colombia: head (top) in dorsal view and meso- and metasoma (bottom) in side view.

ole straight, carinate and slightly denticulate on each side. Ventral process of the petiole very small and subtriangular. Postpetiole slightly shorter than 1/2 of the length of the gastral tergite I (LT4 with convex sides), in dorsal view. Postpetiolar dorsum with a median, short tumulus close to the posterior border. Postpetiolar sternite anteromedially with a marked subround projection. Posterior half of the postpetiolar sternite slightly convex. Constriction between postpetiole and gastral segment I strongly impressed. Gastral tergite I weakly inflates dorsally and with broad, round curvature. Gastral sternite I very short medially, carinate and protruding anteriorly on the sides. Remaining gastral tergites and sternites curved ventrally.

Legs slightly elongate. Mid tibiae without spur. Spurs of fore legs without basal spine. Fore basitarsi longer than the mid ones. Hind basitarsi about 1/4 shorter than hind tibiae. Second tarsomere of mid and hind legs longer than third and fourth tarsomeres, and shorter than pretarsus. Pretarsal claws simple. Arolia small.

Sculpture. Head, mesosoma, petiole, postpetiole and gaster strongly granulate. Legs granulopunctate.

Body covered by hairs of three main types: (1) short, dense, subdecumbent on the whole body, very dense on the tumulus of the basal face of the propodeum, sparse and erect on the funicular joints; (2) long, erect or suberect and sparse on the whole body, absent from the tumulus of the basal face of the propodeum and on the antennae, slightly longer on the petiole, postpetiole and on the gaster; (3) shorter than hair type (1), dense, subdecumbent or appressed on the funicular joints only. In addition the funicular joints bear whitish, thick, appressed, short, sparse hairs, and the scapes with sparse hairs similar to type (2) but shorter.

Colour light ferruginous-brown with slightly lighter antennae and legs.

Measurements in mm and Indices: TL 2.82; HL 0.65; HW 0.57; EL 0.05; SL 0.42; WL 0.80; PeL 0.29; PeW 0.25; HFeL 0.47; HTiL 0.39; HBaL 0.28; LS4 0.14; LT4 0.64; CI 87.7; SI 64.6; IGR 0.22.

MATERIAL EXAMINED: COLOMBIA: NARIÑO: Orito, Territorio Kofan, 00° 30' N 77° 13' W, 1000 m, 25.IX.1998, 1 worker (holotype), E. L. González [IAVH].

DISCUSSION. There are only four species of the *micrommatum* clade sharing the propodeal dorsum with high tumulus covered by short hairs.

Among these, *colombicum* is the smallest species (TL 2.82 mm instead of TL > 3.21 mm for the other 3 species, *brasiliense*, *catio* and *ecuadoriense*). There is another character distinguishing *colombicum* from *brasiliense* only: the postpetiole of *colombicum* is shorter than half of the length of the gastral tergite I (LT4) instead of slightly longer than half in *brasiliense*.

DISTRIBUTION: Colombia.

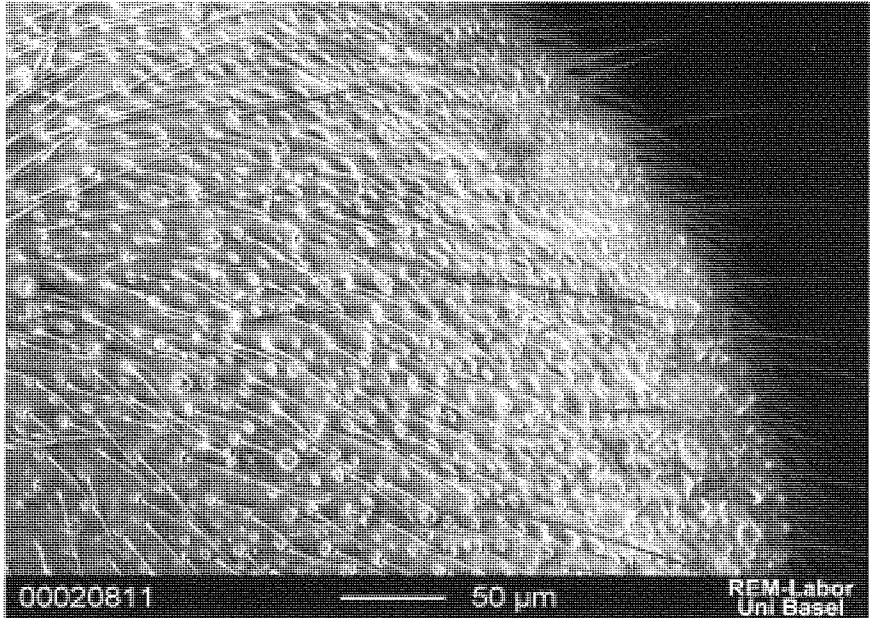


Fig. 61 – *Proceratium colombicum* de Andrade. Worker (holotype) from Orito, Nariño, Colombia: integument of first gastral tergite in side view.

**Proceratium catio** de Andrade n. sp.

Figs. 62, 63, 64

TYPE MATERIAL: holotype worker (unique) from Colombia labelled: "Valle, Bosque El Ensueño, K 27 Vía mar, 1700 m, 5.VI.2000, 1 worker, P. Chacón", deposited in the LACM.

DERIVATIO NOMINIS: this species is named after the Catio, the former inhabitants of this part of Colombia.

DIAGNOSIS. *Catio* is the sister species of *P. brasiliense* (q. v.) but differs from it, in the worker and gyne, by the petiole 1/5 longer than broad instead of at most 1/8 longer than broad, by the postpetiole shorter than 1/2 of the length of the gastral tergite I (LT4) instead of slightly longer and by the postpetiole and gaster, both more convex than in *brasiliense*.

DESCRIPTION. *Worker* (Figs. 62, 63). Head longer than broad, with subparallel sides. Vertex in full face view convex. Clypeus corresponding to a small triangular tooth between the antennal socket. Frontal carinae close to each other, not covering the antennal insertions. Frontal area behind the frontal carinae weakly convex. Lateral expansions of the frontal carinae relatively narrow, raised and diverging posteriorly. Genal carinae strongly marked. Sulcus between the genal carinae and the gular area impressed. Eyes composed by a clearly convex facet slightly below the midline of the head. Scapes thicker in the distal half and far short of the vertexal margin. First funicular joint 1/3 longer than broad. Funicular joints 2-10 broader than long. Last funicular joint as long as the sum of joints 7-10. Mandibles with 5-6 denticles before the apical tooth. Palp formula 3,2.

Mesosoma slightly elongate. Promesopleural and mesometapleural sutures impressed on the ventral half only. Basal face of the propodeum with a high medial tumulus; area behind the propodeal tumulus short, resembling a transversal sulcus with the postero-lateral border carinate. Declivous face of the propodeum flat, the sides crenulate and sub-convex close to the propodeal lobes. Propodeal lobes truncate. Propodeal spiracles tumuliform.

Petiole longer than broad, subparallel in the anterior fourth and convex posteriorly in dorsal view. Anterior border of the petiole straight, strongly carinate and slightly denticulate on each side. Ventral process of the petiole very small and sub-triangular. Postpetiole shorter than 1/2 of the gastral ter-

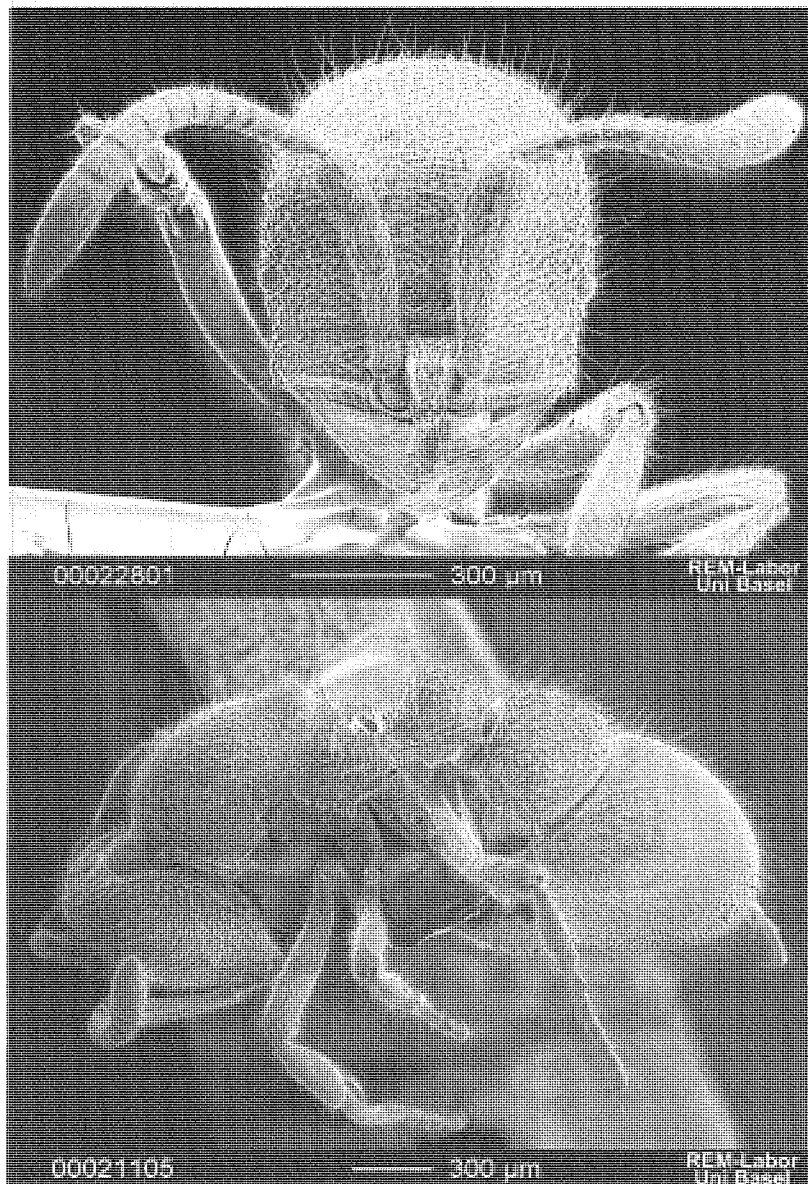


Fig. 62 – *Proceratium catio* de Andrade. Worker (holotype) from Bosque El Ensueño, Valle, Colombia: head (top) in dorsal view and meso- and metasoma (bottom) in side view.



gite I (LT4), with the sides strongly convex in dorsal view. Postpetiolar dorsum with a median, short tumulus close to the posterior border. Postpetiolar sternite anteromedially with a marked, subround projection. Posterior half of the postpetiolar sternite slightly convex. Constriction between postpetiole and gastral segment I strongly impressed. Gastral tergite I convex dorsally and round on the curvature. Gastral sternite I (LS4) very short medially, carinate and slightly protruding anteriorly on the sides. Remaining gastral tergites and sternites curved ventrally.

Legs slightly elongate. Mid tibiae without spur. Spurs of fore legs without a basal spine. Fore basitarsi longer than the mid ones. Hind basitarsi about 1/4 shorter than hind tibiae. Second tarsomere of mid and hind legs longer than the third and fourth tarsomeres and shorter than pretarsus. Pretarsal claws simple. Arolia small.

Sculpture. Head granulopunctate and irregularly rugulose. Mesosoma granulate, with short, irregular rugae and with sparse, very irregular, superficial foveae. Petiole and postpetiole granulate-foveolate, the granulation raised to form small peaks and the foveae deeper than on the mesosoma. Anterior half of the gaster smooth and with rare, small granulation. Posterior half of the gaster with strong, dense granules.

Body covered by hairs of three main types: (1) short, dense, subdecumbent on the whole body, very dense on the tumulus of the basal face of the propodeum, sparse and erect on the funicular joints; (2) long, erect or suberect and slightly dense on the whole body, absent from the tumulus of the basal face of the propodeum and on the antennae, slightly longer on the petiole, postpetiole and on the gaster; (3) shorter than hair type (1), dense, subdecumbent or appressed on the funicular joints only. In addition the funicular joints bear whitish, thick, appressed, short, sparse hairs, and the scapes with sparse hairs similar to type (2) but shorter.

Colour dark ferrugineous with slightly lighter antennae and legs.

Measurements in mm and Indices: TL 3.38; HL 0.79; HW 0.68; EL 0.06; SL 0.49; WL 0.91; PeL 0.36; PeW 0.29; HFeL 0.60; HTiL 0.50; HBaL 0.37; LS4 0.14; LT4 0.78; CI 86.1; SI 62.0; IGR 0.18.

*Gyne* (tentative attribution). Differing from the worker in the following details: eyes large, about 1/4 of the head length and with interocellar pilos-

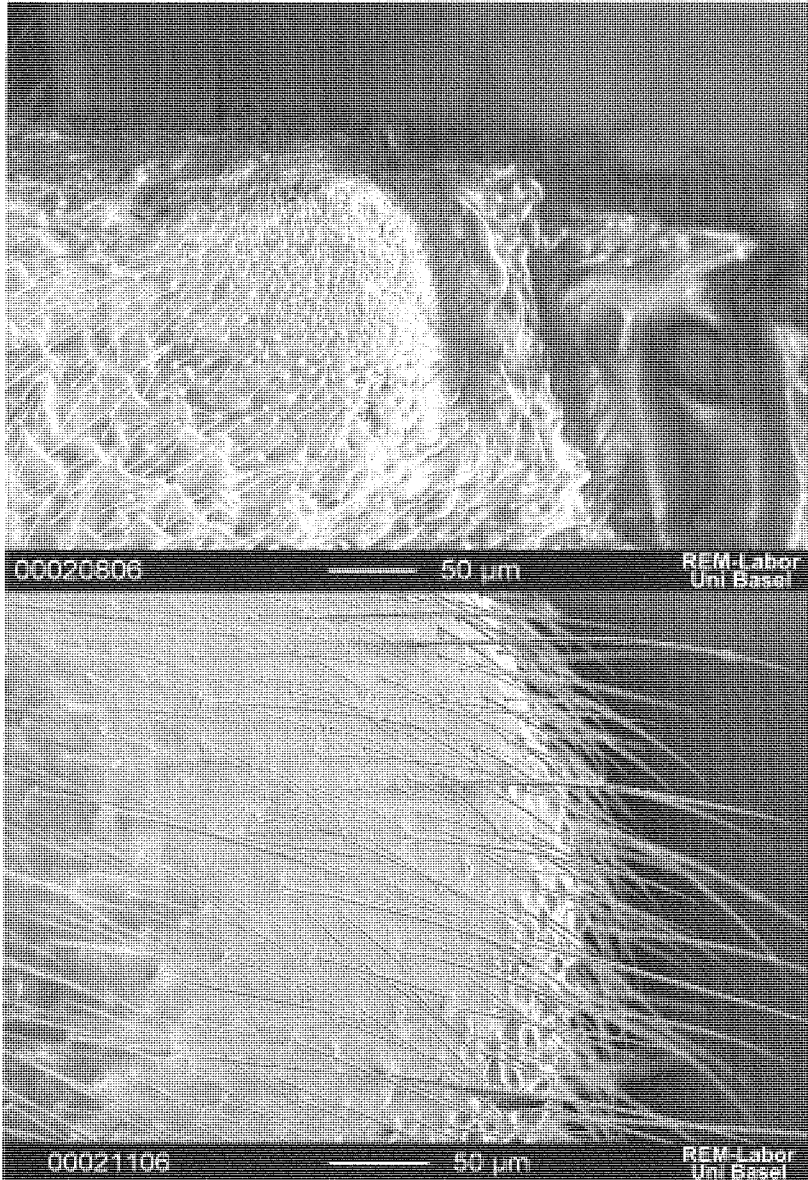


Fig. 63 – *Pseceratium casto* de Andrade. Worker (holotype) from Bosque El Ensueño, Valle, Colombia: propodeal tumulus (top) in dorsal view and integument of first gastral tergite (bottom) in side view.

ity. Ocelli well developed. Funicular joints 2-10 slightly broader than long. Mandibles with 5-6 denticles before the apical tooth.

Mesosoma robust and convex in profile. Parapsidal furrows marked. Scutellum convex. Metanotum without tooth or spine-like projection. Basal face of the propodeum short and separate from the declivous face by a carina more marked and sub-angulate laterally .

Fore wings of our type 4, hind wings of our type 3 as defined in the description of the genus (Fig. 64).

Sculpture. Rugosities on the mesosoma weakly arranged longitudinally. Mesosoma and scutellum without foveae.

Pilosity as in the worker except for the hair type (2) slightly shorter, rare on the basal face of the propodeum.

Colour light ferruginous.

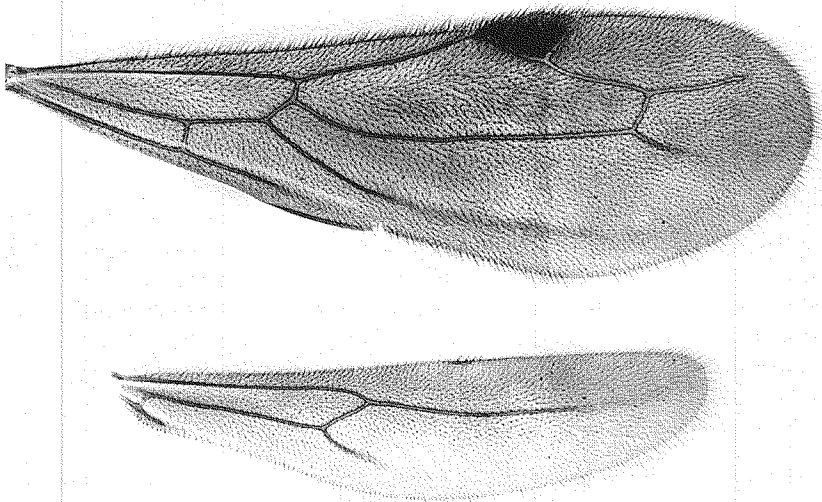


Fig. 64 – *Proceratium catio* de Andrade. Gyne from PNN Ucumari, Risaralda, Colombia, fore and hind wings.

Measurements in mm and Indices: TL 3.40-4.03; HL 0.73-0.87; HW 0.62-0.74; EL 0.18-0.21; SL 0.45-0.55; WL 0.96.1.20; PeL 0.34-0.39; PeW 0.28-0.31; HFeL 0.56-0.71; HTiL 0.45-0.58; HBaL 0.32-0.45; LS4 0.16-0.20; LT4 0.85-0.98; CI 84.9-85.0; SI 61.6-63.2; IGR 0.19-0.20.

MATERIAL EXAMINED: COLOMBIA: RISARALDA: PNN Ucumarí, 1800 m, B. sec. 1 gyne, pitfall, Usma & Al [IAVH]. VALLE: Bosque El Ensueño, km 27 Vía mar, 1700 m, 5.VI.2000, 1 worker (holotype), P. Chacón [LACM]. Isla Gorgona: 10.XI.1990, 1 gyne, M. L. Baena [MZSP].

DISCUSSION. We attribute with few reserves the gynes from Risaralda and from Isla Gorgona to *catio* because of the similarities in sculpture and pilosity and geographic vicinity with the workers. The gyne from Isla Gorgona differs from the gyne from Risaralda mainly by its smaller size.

DISTRIBUTION: Colombia.

### ***Proceratium brasiliense* Borgmeier**

Figs. 65, 66

*Proceratium brasiliense* Borgmeier, 1959: 309, figs. 1 & 2. Worker. Original description. Type locality: Nova Teutônia, Xaxim, Cantareira, Brazil. Type material: two syntype workers labelled: "Brasilien Nova Teutonia, 27°11' B 52°23' L, 300 bis 500 mm, VIII.1957, X.1957, Fritz Plaumann; Cotypus; Syntypus; *Proceratium brasiliense* Cotype, det. Borgmeier"; one syntype worker labelled: "Xaxim, SC, XII.1957, F. Plaumaun, Cotypus, Syntypus"; one worker labelled: Cantareira, SP, 1.II.59, Kempf & Santos, Cotypus, Syntypus", all in MZSP, examined.

*Proceratium brasiliense* Borgmeier, Snelling, 1967: 9 (identification key).

*Proceratium brasiliense* Borgmeier, Brown, 1980: 343 (identification key).

*Proceratium brasiliense* Borgmeier, Ward, 1988: 117 (identification key).

DIAGNOSIS. The sister species of *P. catio* (q. v.), but differs from it, in the worker and gyne, by the petiole 1/8 longer than broad instead of 1/5 longer than broad, by the postpetiole longer than 1/2 of the gastral tergite I (LT4) instead of slightly shorter, and by the postpetiole and gaster less convex than in *catio*.

DESCRIPTION. *Worker* (Fig. 65). Head slightly longer than broad and with subparallel sides. Vertex convex in full face view. Clypeus corresponding to a small triangular tooth between the antennal sockets. Frontal carinae close to each other, not covering the antennal insertions. Frontal area behind the frontal carinae weakly convex. Lateral expansions of the frontal carinae relatively narrow, raised, diverging or subparallel. Genal carinae present and well marked. A superficial sulcus between the genal carinae and the gular area. Eyes present, composed by a clearly convex facet slightly below the midline of the head. Scapes thicker in the distal half and short of the vertexal margin. First funicular joint  $1/3$  longer than broad. Funicular joints 2-10 broader than long. Last funicular joint as long as the sum of joints 7-10. Mandibles with 3-4 denticles before the apical tooth. Palp formula 3,2.

Mesosoma slightly elongate. Promesonotal suture superficially impressed. Promesopleural and mesometapleural sutures impressed on the ventral half only. Basal face of the propodeum with a relatively high tumulus medially; area behind the propodeal tumulus with a superficial transversal sulcus; postero-lateral border of the sulcus with or without a minute, carinate angle. Declivous face of the propodeum flat; its sides submarginate. Propodeal lobes ventrally truncate and dorsally round. Propodeal spiracles small.

Petiole slightly longer than broad, with sides subparallel in the anterior fourth and convex posteriorly in dorsal view. Anterior border of the petiole with a superficially carinate tooth on each side, the teeth separated by a concavity. Ventral process of the petiole with one or two minute denticles followed or not by a small spine. Postpetiole longer than  $1/2$  of the gastral tergite I (LT4), with the sides gently convex in dorsal view. Postpetiolar sternite anteromedially with a marked subtriangular projection. Posterior half of the postpetiolar sternite slightly convex. Constriction between postpetiole and gastral segment I impressed. Gastral tergite I broad and round. Gastral sternite I very short medially. Remaining gastral tergites and sternites curved ventrally.

Legs slightly elongate. Mid tibiae without spur. Spurs of fore legs without basal spine. Fore basitarsi longer than the mid ones. Hind basitarsi about  $1/5$  shorter than hind tibiae. Second tarsomere of mid and hind legs longer than third and fourth tarsomeres, and shorter than pretarsus. Pretarsal claws simple. Arolia small.

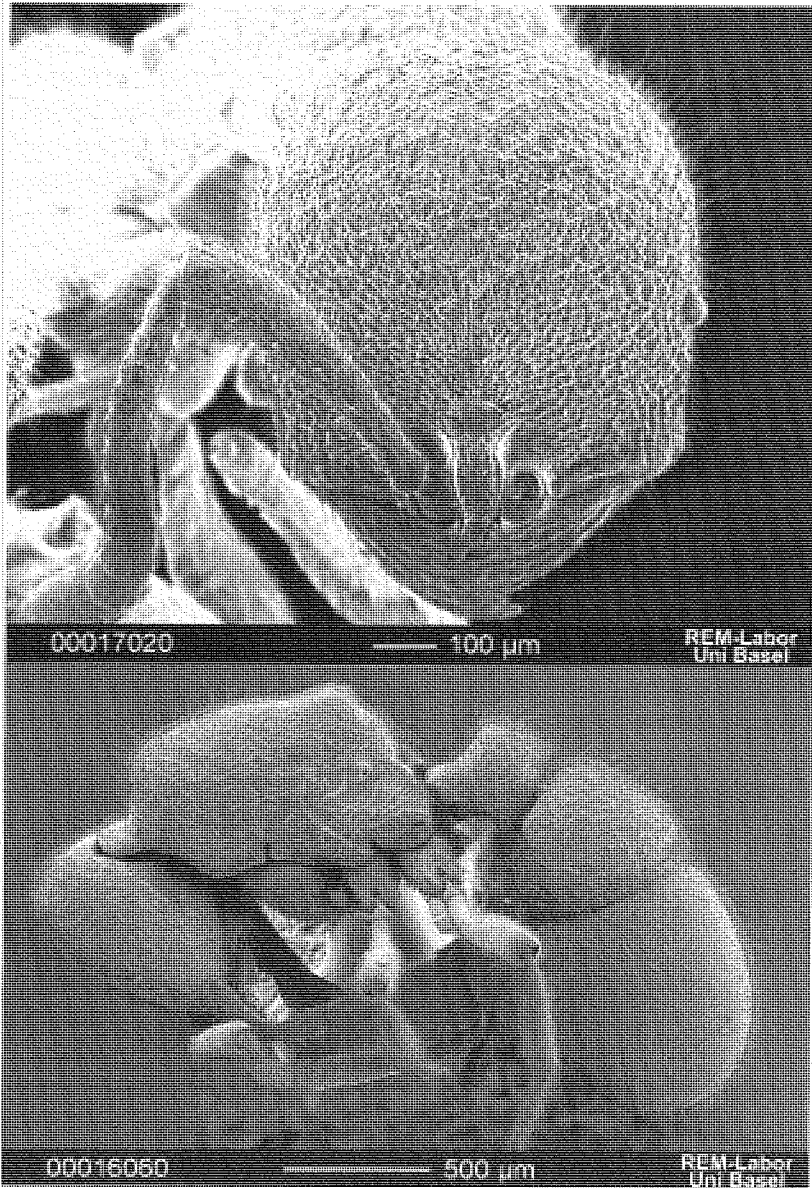


Fig. 65 – *Proceratium brasiliense* Borgmeier. Worker from Ilhéus-Itabuna, Bahia, Brazil: head (top) in dorsal view and meso- and metasoma (bottom) in side view.

Sculpture. Head, mesosoma, petiole and postpetiole granulate, and with traces of very superficial, small, irregular, foveae-like depressions. Few, irregular, short rugosities may be present between these structures. Dorsum of the first gastral tergite smooth and with minute piligerous punctures and very sparse minute granulation; area after the gastral curvature and sides of the gaster granulate. Scapes and legs less granulate than the other body parts.

Body covered by hairs of three main types: (1) short, dense, subdecumbent on the whole body, sparse and erect on the funicular joints; (2) long, erect or suberect and sparse on the whole body, absent from the tumulus of the basal face of the propodeum and on the antennae, slightly longer on the petiole; (3) shorter than hair type (1), dense, subdecumbent and appressed on the funicular joints only. In addition the funicular joints bear whitish, thick, appressed, short, sparse hairs, and the scapes with sparse hairs similar to type (2) but shorter.

Colour light or dark ferruginous. Antennae and legs lighter.

Measurements in mm and Indices: TL 3.40-3.86; HL 0.77-0.90; HW 0.70-0.80; EL 0.05-0.06; SL 0.52-0.58; WL 0.94-1.03; PeL 0.35-0.36; PeW 0.31-0.34; HFeL 0.62-0.70; HTiL 0.51-0.59; HBaL 0.41-0.48; LS4 0.15-0.18; LT4 0.77-0.94; CI 88.9-91.7; SI 64.4-67.5; IGR 0.19-0.22.

*Gyne* (previously undescribed). It differs from the worker in the following details: eyes large, about 1/4 of the head length and with ocular pilosity. Ocelli well developed. Funicular joints 2-10 slightly broader than long. Mandibles with 4-5 denticles before the apical tooth.

Mesosoma robust and convex in side view. Parapsidal furrows marked. Scutellum convex. Metanotum without tooth or spine-like projection. Basal face of the propodeum very short, with or without a denticle on each side, medially incised and almost indistinguished from the declivous face.

Petiole in dorsal view subparallel in the anterior third or fourth and convex posteriorly. Anterior and dorsal faces of the petiolar node less convex. Postpetiole in dorsal view with convex sides.

Fore wings of our type 4, hind wings of our type 3 as defined in the description of the genus (Fig. 66).

Sculpture as in the worker.

Pilosity as in the worker except for the hair type (2) present on the whole propodeum.

Colour light ferruginous.

Measurements in mm and Indices: TL 3.65-4.21; HL 0.79-0.89; HW 0.70-0.82; EL 0.20-0.21; SL 0.57-0.72; WL 1.08-1.20; PeL 0.32-0.36; PeW 0.30-0.34; HFeL 0.69-0.83; HTiL 0.55-0.66; HBaL 0.45-0.56; LS4 0.16-0.22; LT4 0.85-1.05; CI 89.9-92.2; SI 72.1-80.9; IGR 0.19-0.21.

MATERIAL EXAMINED: BRAZIL: BAHIA: Ilhéus, 1986, 1 worker, J. H. C. Delabie [CPCC]; same locality, 2.VI.1994, 2 gynes, J. H. C. Delabie [CPCC]; Km 22 Ilhéus-Itabuna, área Zoologia, X.1986, 1 worker, J. H. C. Delabie [MZSP]. SÃO PAULO: São Paulo, Serra da Cantareira, 1.III.1959, 1 worker (syntype), Kempf & Santos [MZSP]. SANTA CATARINA: Nova Teutônia, 27°11' B, 52°23' L, VIII & X.1957, 2 workers (syntypes), F. Plaumann [MZSP]; same locality, VI.1958, 1 worker labelled as syntype, F. Plaumann [MZSP]; same locality, VII.1959, II, V, VI, X.1960, VI.1963, VII.1969,

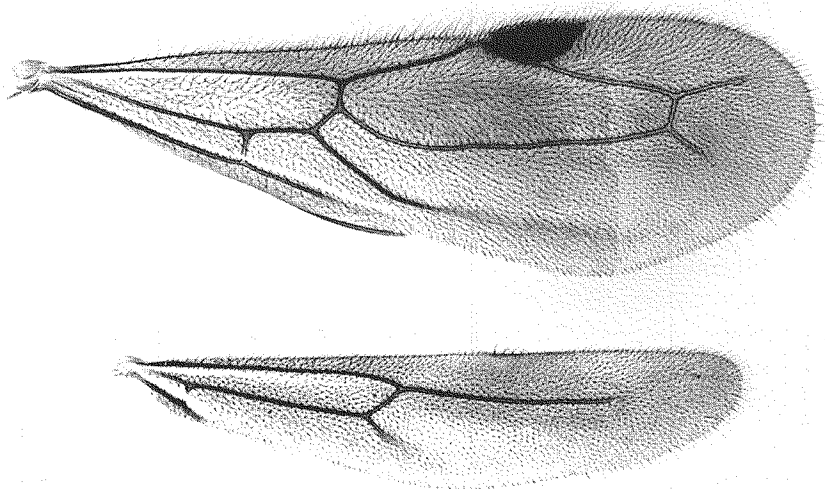


Fig. 66 – *Proceratium brasiliense* Borgmeier. Gyne from Ilhéus-Itabuna, Bahia, Brazil, fore and hind wings.



XII.1972, 11 workers, 1 gyne, F. Plaumann [MCZC, MZSP]; Xaxim, XII.1957, 1 worker (syntype), F. Plaumann [MZSP]; Ibicaré, 600 m, IX.1960, 1 worker, F. Plaumann [MZSP].

DISCUSSION. WARD (1988) considers *brasiliense* only weakly differentiated from *micrommatum* and suggests that the first may be a junior synonym of the latter. This statement is accompanied by a contradictorily guess about "the possibility... that it [*micrommatum*] comprises more species". This judgement is likely to be a plain consequence of the previous confusion around a supposedly very variable "*micrommatum*". What was considered as "*micrommatum*" before plus other additional, pertinent records are actually divided into five closely related species in the present revision. Examination of the types of both species, *brasiliense* and *micrommatum*, however, proves that the two are very distinct from each other. This difference applies equally well to all the additional material of the two species examined during the present study.

The gynes from Bahia differ from the gyne from Nova Teutônia by the smaller size and by the shorter scapes.

DISTRIBUTION: Brazil

### ***Proceratium convexiceps* Borgmeier revised status**

Figs. 67, 68, 69, 70

*Proceratium convexiceps* Borgmeier, 1957: 120, figs. 34 & 35. Worker. Original description. Type locality: San José, Costa Rica. Type material: holotype worker labelled: "San Jose, C. Rica, H. Schmidt, typus, MCZ, H-type, 29766, det. Borgmeier", in MCZC, examined.

*Proceratium convexiceps* (Borgmeier), Snelling, 1967: 9 (identification key).

*Proceratium micrommatum* (Roger), [*convexiceps* Borgmeier junior synonym of *micrommatum*] Brown, 1980: 342. Nec Roger, 1863. Partim. Misidentification.

DIAGNOSIS. A *Proceratium* species belonging to the *micrommatum* clade, resembling *mexicanum*, but differing from it, in the worker, by the area between basal and declivous faces of the propodeum with at most a faint, lateral, transversal carina instead of well marked, in the gyne, by the area between basal and declivous faces of the propodeum weakly angulate instead

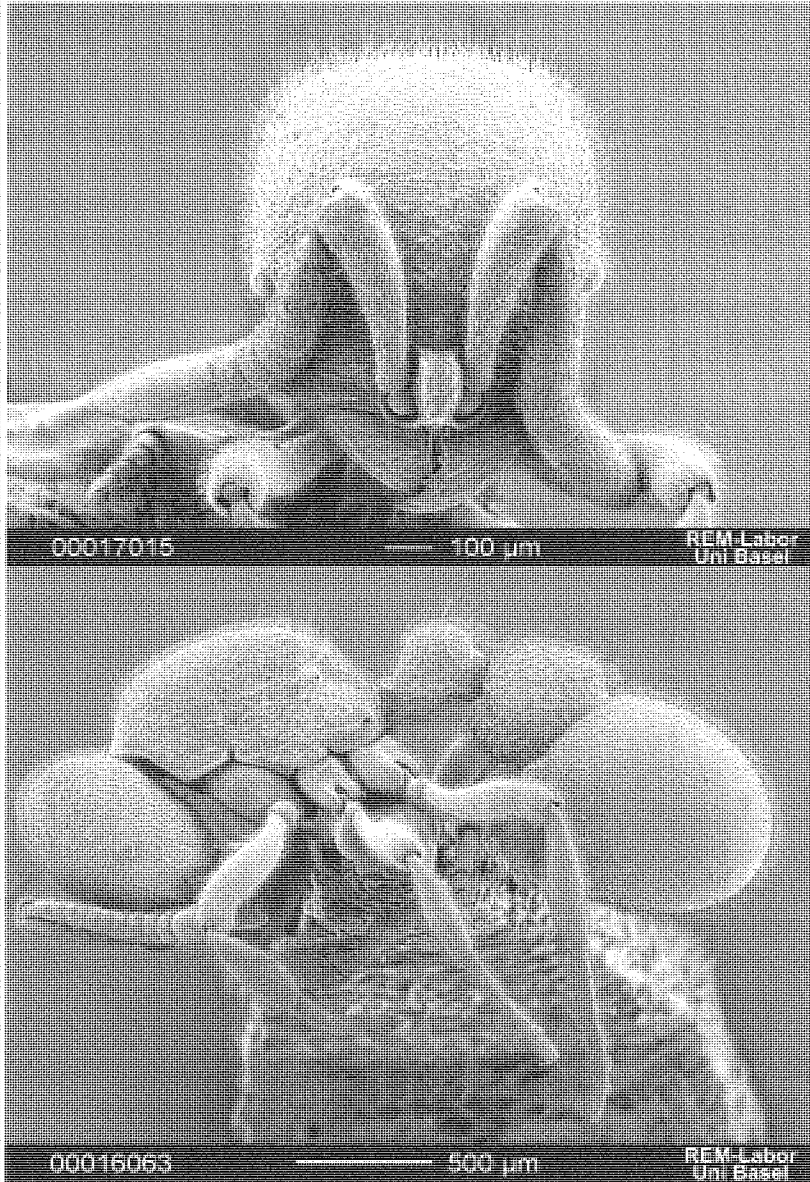


Fig. 67 – *Proceratium convexiceps* Borgmeier. Worker from Monte Verde, Puntarenas, Costa Rica: head (top) in dorsal view and meso- and metasoma (bottom) in side view.

of carinate and angulate, and in the worker and gyne by the deeper body sculpture.

DESCRIPTION. *Worker* (Fig. 67). Head longer than broad, slightly narrower anteriorly than posteriorly. Vertex in full face view straight or gently convex. Clypeus very reduced medially, subtriangular, between and much shorter than the antennal sockets. Antennal socket with broad torulus. Frontal carinae close to each other, not covering the antennal insertions. Frontal area behind the frontal carinae weakly convex. Lateral expansions of the frontal carinae relatively narrow, raised, gently convex or subparallel. Genal carinae present and well marked. A superficial sulcus between the genal carinae and the gular area. Eyes present, composed by a clearly convex facet below the midline of the head. Scapes thicker in the distal half and far short of the vertexal margin. First funicular joint  $1/3$  longer than broad. Funicular joints 2-10 broader than long. Last funicular joint as long as the sum of joints 6-10. Mandibles with 3-4 denticles before the apical tooth. Palp formula 3,2.

Mesosoma convex in profile. Promesonotal and propodeal sutures absent. Promesopleural and mesometapleural sutures impressed on the ventral half only. Basal face of the propodeum gently declivous and with traces of a superficial, transversal sulcus close to the declivous face; the sulcus without or with traces of a faint, postero-lateral carina. Declivous face of the propodeum with the sides superficially marginate, the margin variably crenulate. Propodeal lobes subround and with variably crenulate margin. Propodeal spiracles small and tumuliform.

Petiole slightly longer than broad. Petiole in dorsal view with the sides subparallel in the anterior fifth and convex posteriorly. Anterior border of the petiole gently concave and carinate. Ventral process of the petiole subtriangular and small. Postpetiole about  $1/2$  of the length of the gastral tergite I (LT4). Postpetiole in dorsal view anterolaterally subround and with convex sides. Postpetiolar dorsum with a tumulus close to the posterior border. Postpetiolar sternite anteromedially with a marked subtriangular projection. Posterior half of the postpetiolar sternite straight or slightly convex. Constriction between postpetiole and gastral segment I deeply impressed. Gastral tergite I strongly convex on the curvature. Gastral sternite I very short medially. Sides of gastral sternite I obtuse and protruding anteriorly. Remaining gastral tergites and sternites curved ventrally.

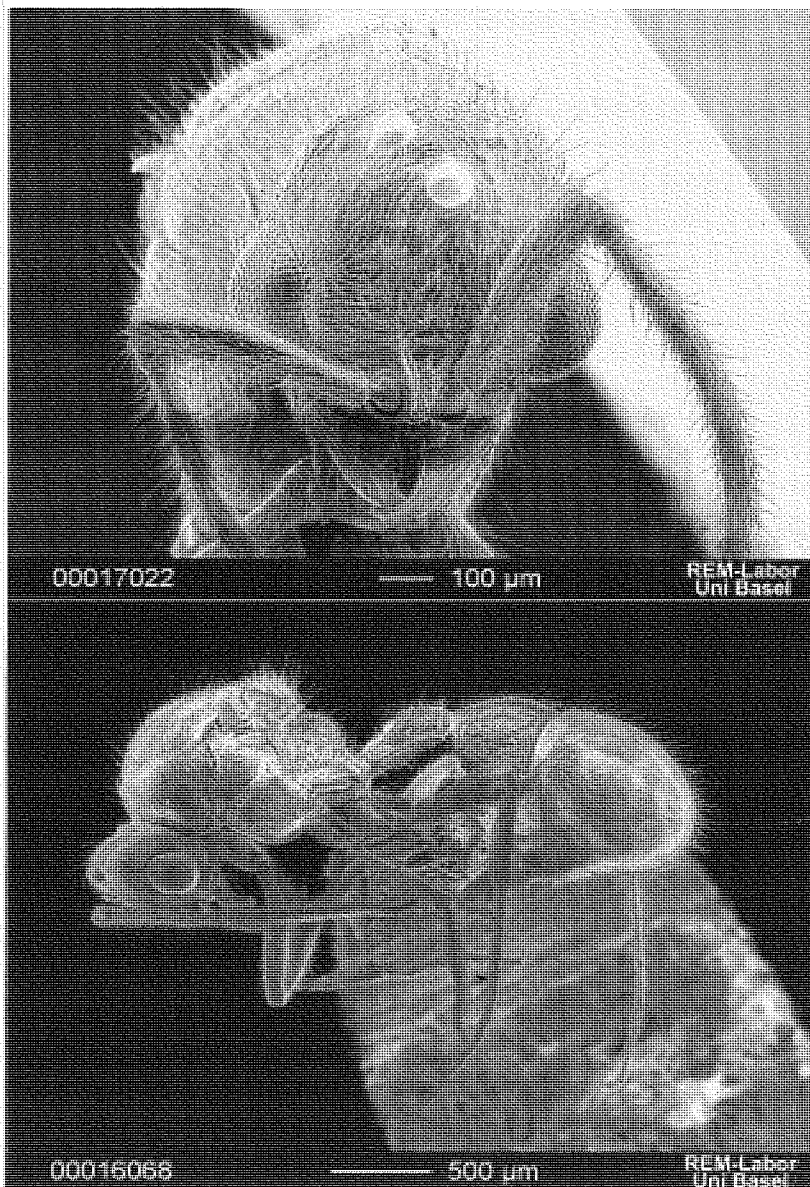


Fig. 68 – *Proceratium convexiceps* Borgmeier. Male from San Luis de Monteverde, Puntarenas, Costa Rica: head (top) in dorsal view and meso- and metasoma (bottom) in side view.

Legs moderately elongate. Mid tibiae without spur. Spurs of fore legs without basal spine. Fore basitarsi longer than the mid ones. Hind basitarsi about 1/5 or 1/4 shorter than the hind tibiae. Second tarsomere of mid and hind legs longer than the third and fourth tarsomeres and slightly shorter than pretarsus. Pretarsal claws simple. Arolia small.

Sculpture. Head, mesosoma, petiole and postpetiole reticulate-punctate and granulate, the granules sparse on the head and mesosoma, denser and larger on the petiole and postpetiole. Mesosoma, petiole and postpetiole with additional foveae, superficial, sparse and small on the mesosoma, deeper and denser on the petiole and postpetiole. First gastral tergite smooth and with minute, sparse piligerous punctures, the punctures denser, larger and mixed with reticulation on its sides and posterior border. Legs and antennae superficially granulate-punctate.

Body covered by hairs of three main types: (1) short, dense, subdecumbent on the whole body, sparse and suberect on the funicular joints; (2) long, suberect and relatively dense on the whole body, slightly shorter on the head, absent from the antennae; (3) shorter than hair type (1), dense, decumbent on the funicular joints only. In addition the funicular joints bear whitish, thick, appressed, short, sparse hairs, and the scapes with sparse hairs similar to type (2) but shorter.

Colour dark ferruginous or dark brown with antennae and legs lighter.

Measurements in mm and Indices: TL 3.04-3.58; HL 0.69-0.80; HW 0.63-0.70; EL 0.05-0.07; SL 0.43-0.56; WL 0.81-0.96; PeL 0.32-0.39; PeW 0.25-0.32; HFeL 0.52-0.67; HTiL 0.44-0.56; HBaL 0.28-0.44; LS4 0.13-0.14; LT4 0.73-0.87; CI 87.5-91.5; SI 60.5-70.0; IGR 0.16-0.18.

*Gyne*. Differing from the worker in the following details: eyes larger, less than 1/3 of the head length and with ocular pilosity. Ocelli well developed.

Mesosoma robust and convex in side view. Parapsidal furrows weakly marked. Scutellum with the sides converging posteriorly and with the posterior border rounded. Metanotum without tooth or spine-like projection. Basal face of the propodeum very short, laterally weakly angulate, medially incised and as flat as the declivous face.

Petiole longer than broad.

Measurements in mm and Indices: TL 3.47; HL 0.72; HW 0.67; EL 0.20; SL 0.45; WL 1.00; HFeL 0.58; HTiL 0.49; HBaL 0.34; LS4 0.15; LT4 0.89; CI 91.8; SI 61.6; IGR 0.17.

*Male* (Fig. 68) (tentative attribution). Head slightly longer than broad. Vertex in full face view convex. Vertexal margin weakly carinate. Clypeus medially extremely reduced, subround, between and about as long as the antennal sockets. Antennal socket with broad torulus. Frontal carinae thin, low, diverging posteriorly and separated from each other. Anterior half of the frons gently convex and with a variably impressed longitudinal ridge, posterior half concave. Ocelli very large. Compound eyes slightly less than  $1/2$  of the head length, placed largely on the anterior head sides and with interocellar pilosity. Scapes reaching the pair ocelli or slightly surpassing them (in the specimen from Tempisque). First funicular joint thicker than the second joint and slightly broader than  $1/2$  of its length. Funicular joints 2-11 about  $1/2$  longer than broad. Last funicular joint about as long as the

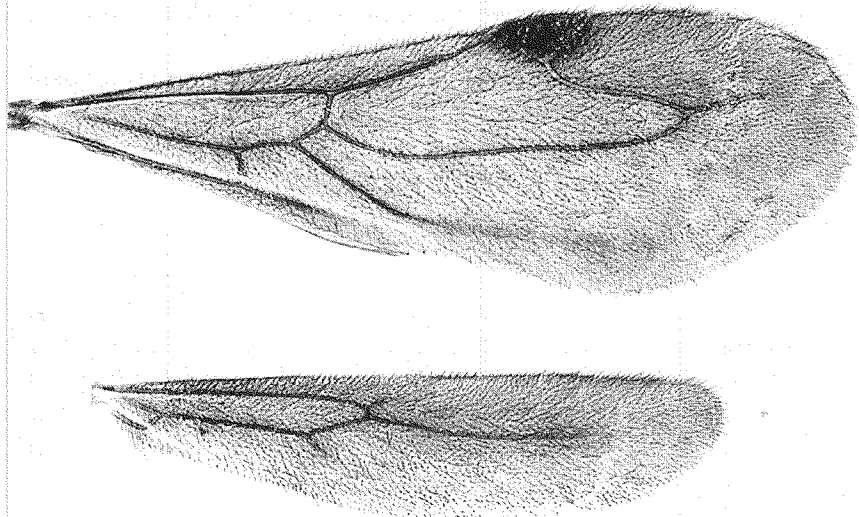


Fig. 69 – *Proceratium convexiceps* Borgmeier. Male from San Luis de Monteverde, Puntarenas, Costa Rica: fore and hind wings.

sum of joints 9-11. Mandibles elongate, edentate, only with a single, pointed apical tooth. Palp formula 3,2.

Mesosoma robust. Pronotum perpendicular to the mesonotum. Mesonotum convex. Parapsidal furrows marked. Scutellum as high as the mesonotum and in full dorsal view with round posterior border. Propodeum in side view gently convex or sloping posteriorly, basal and declivous faces of the propodeum not clearly separated. Metanotum without a median spine-like projection. Propodeal lobes small and subround. Propodeal spiracles small and slightly oriented downwards.

Petiole in profile declivous on the anterior third and convex on the two posterior thirds. Petiole in dorsal view with parallel sides in the anterior third, the remaining two posterior thirds gently convex anteriorly and parallel posteriorly. Anterior border of the petiole concave and superficially carinate. Subpetiolar process in form of a narrow, subtriangular, longitudinal lamella. Postpetiole weakly convex in side view. Postpetiole anteriorly slightly broader or about as broad as the petiole; postpetiolar sides diverging and gently convex posteriorly. Anterior border of the postpetiolar sternite without a projecting triangular "lip". Gastral tergite I round. Gastral sternite I broad in the middle. Remaining gastral tergites and sternites curved ventrally.

Legs elongate. Hind basitarsi about as long as the hind tibiae.

Fore wings of our type 5, hind wings of our types 2 and 3 as defined in the description of the genus (Fig. 69).

Genitalia as in Fig. 70.

Sculpture. Head, pronotum, mesonotum, pro- and mesopleurae, and scutellum variably granulate and with rare, thin, rugosities, the granulation sparse on the dorsum of the pronotum and mesonotum and larger on the scutellum. Propodeum with dense impressions resembling irregular foveae. Metapleurae with thick, irregular rugosities. Petiole granulate-rugulose on the anterior third and on the whole sides, its dorsum more smooth. Postpetiole and first gastral tergite with minute piligerous foveae and with granulation on their sides, the granulation rarer and smaller on the sides of the gaster. Legs minutely punctate.

Body covered essentially by hairs of three main types: (1) short, dense, subdecumbent on the whole body; (2) long, suberect and relatively dense on the whole body, slightly longer on the petiole, postpetiole and gaster; (3) shorter than hair type (1), dense, decumbent on the funicular joints. In addi-

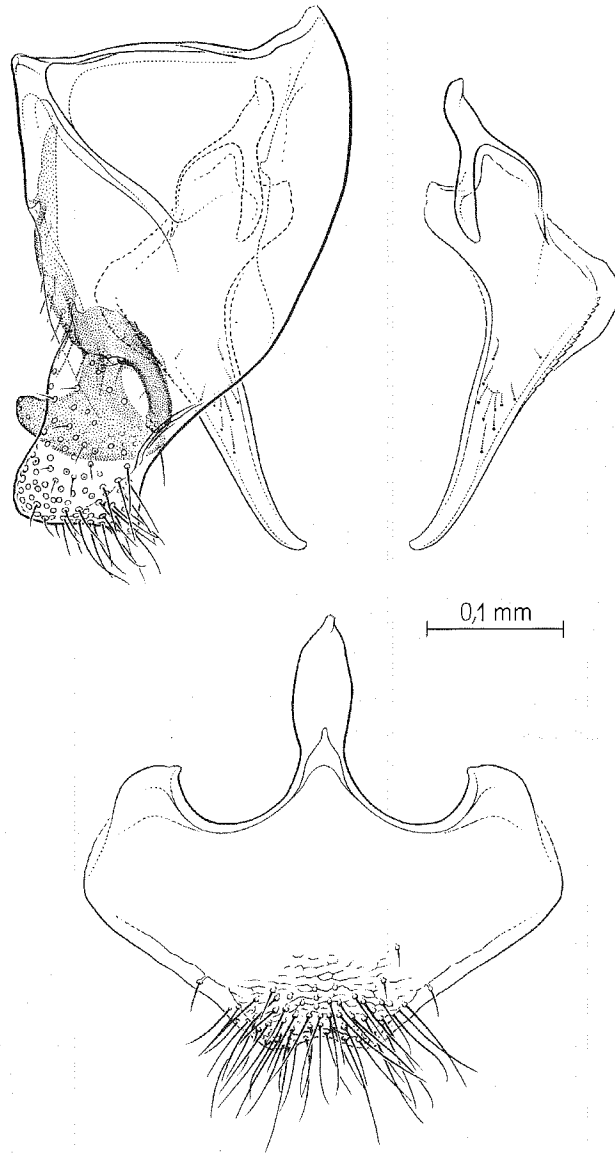


Fig. 70 – *Proceratium convexiceps* Borgmeier. Male from San Luis de Monteverde, Puntarenas, Costa Rica. Genital appendages: a) lateral view of left parameres and of their relative positions; b) right aedeagus in profile; c) subgenital plate in ventral view.



tion the funicular joints bear whitish, thick, appressed, short, sparse hairs, the scapes and the funicular joints with hairs similar to type (1) but longer.

Colour. Dark brown to black.

Measurements in mm and Indices: TL 3.36-3.78; HL 0.56-0.63; HW 0.54-0.59; EL 0.26-0.29; SL 0.42-0.52; WL 1.10-1.20; PeL 0.39-0.44; PeW 0.22-0.28; HFeL 0.73-0.88; HTiL 0.55-0.68; HBaL 0.54-0.66; LS4 0.25-0.30; LT4 0.73-0.92; CI 93.1-96.5; SI 75.0-82.5; IGR 0.32-0.35.

MATERIAL EXAMINED: MEXICO: GUERRERO: 7.2 km NW El Ocotito, 853 m, oak-pine-Acacia, 8.VII.1987, 1 worker, R. Anderson [MCZC]. COSTA RICA: San José, 1 worker (holotype), H. Schmidt [MCZC]; Puntarenas, Monteverde, 10°18' N 84°47-48' W, 1540-1560 m, 12 & 18.VII.1984, cloud forest, litter sample ground, 2 workers, J. Longino [INBC]; same locality, 14.XII.1987, 15.VI.1991, 1500m, 3 workers, J. Longino [INBC]; Puntarenas, San Luis de Monteverde, 10°17' N 84°49' W, 1100 m, 1.V.1998, 1 male, L. La Pierre [LACM]; Tempisque, 8.III.1937, 1 male, A. Alfaro [USNM]; Zurqui, 1600 m, 25-31.IX.1998, flight intercept trap, 4 males, C. & L. O'Brien [MCZC]; same locality, 1-9.IX.1998, flight intercept trap, 2 males, C. W. & L. O'Brien [MCZC]; Province Guanacaste, Finca La Pacifica, 10°27' N 88°08' W, 40 m, 16-17.VII.1985, 1 worker, J. Longino [INBC]; Guanacaste Province, cacao Field Station, 15.II.1996, 1400 m, 1 worker, R. Anderson [WEMC]. PANAMA: Chiriqui, Fortuna, Hydrological trail, 1100 m, 9.VI.1995, 1 worker, R. Anderson [WEMC]; Chiriqui, Fortuna area, Finca La Suisse, 10-12.VI.1995, forest litter, 7 workers, R. Anderson [WEMC]; Chiriqui, Boca del Toro, 9.VI.1995, 3 workers, 1 gyne, R. Anderson [WEMC].

DISCUSSION. The first description of *P. convexiceps*, from Costa Rica, is that of Borgmeier (1957) who gave a list of 12 characters distinguishing it from *micrommatum*. Brown (1974) suggests that the main character splitting the two species is the presence-absence of a median clypeal tooth, a variable character. Later on he formally proposed the synonymy between the two species by stressing the fluidity of clypeal morphologies among these ants (Brown, 1980). In the same paper Brown (l. c.) added that Borgmeier (1957) described *convexiceps* by comparing it with a Cuban subergatoid gyne of *micrommatum* and that the differences between *convexiceps* and *micrommatum* were only allometric caste differences. We exam-

ined the holotypes of *convexiceps*, of *micrommatum* and the sub-ergatoid gyne of *micrommatum* from Cuba (Soledad). This sub-ergatoid gyne of *micrommatum* is morphologically 100% worker except for its larger eyes (0.09 mm) composed by facets with few interocellar hairs. The specimen in question also has the vertex with three small dark spots instead of ocelli.

We prefer to call this intercaste as "sub-ergatoid". True ergatoid gynes should exhibit traits of the gyne morphological syndrome in the head and in the mesosoma. In *Proceratium* we encountered true ergatoid gynes in the species *avioide* and *deelemani*. The reason of our distinction between ergatoid and sub-ergatoid gynes is that only from the second category the worker morphology can be inferred with confidence.

The head of the Cuban sub-ergatoid specimen from Soledad is detached from the body and the left funiculus detached from the head. We studied another single worker from Cuba (Holguín) similar to the one examined by Borgmeier (1957). The worker from Holguín differs from the Soledad specimen mainly by the absence of dark spots on the vertex and by the smaller eyes composed each by a single facet without ocular pilosity.

It is true that Borgmeier (1957) described *convexiceps* from a single specimen and, as a consequence of this, he had no idea of its variability. On the other hand, 3 of the 12 characters he originally listed to separate *convexiceps* from *micrommatum* hold for all the specimens of the two species we examined. These are Borgmeier's characters No. 6, 11 and 12. To these three good characters we add another two as resulting from the comparison between several related species reported in the discussion of *cubanum* (q. v.).

We cannot agree, hence, on the synonymy between *convexiceps* and *micrommatum*. In addition, the sub-ergatoid gyne from Cuba is also not *micrommatum*. This and another specimen from Cuba available for the present study belong to a new species to be described later in this paper as *cubanum*.

A worker from Finca La Pacifica (INBC) differs from the other *convexiceps* workers by the longer hind and mid basitarsi (HBaL 0.42 mm, MBaL 0.25 mm) as compared with those of other workers of the same size (HBaL 0.35 mm, MBaL 0.20 mm). In addition, this specimen has deeper and denser punctuation resembling small foveae on the mesosoma and the gastral sternite is not protruding anteriorly.

A Mexican worker from El Ocotito (MCZC) differs from the other *con-*

*vexiceps* workers by the petiole as broad as long instead of slightly longer than broad, by the stout mesosoma with sculpture much similar to the one of the worker from Finca La Pacifica.

We can not exclude the possibility that these two workers may represent one or two undescribed species.

The specimens from Panama differ from the others by the smaller size.

We tentatively attributed 5 Costa Rican males belonging to the *micrommatum* clade to *convexiceps* for the following reasons: (1) one of these males was collected in San Luis de Monteverde (Puntarenas), an area where workers of two species of the *micrommatum* clade (*convexiceps* and *panamense*) were collected, (2) in *Proceratium* the males may be smaller, as large as or larger than the workers, but the WL of *Proceratium* males are always much larger than the WL of their largest workers. These 5 Costa Rican males have WL 1.10-1.20 mm as compared to WL 0.81-0.96 mm in the *convexiceps* worker. The second species of this clade known from the area (*panamense*) has a worker WL 1.05-1.30 mm. Our attribution is hence the most plausible solution though it needs confirmation.

DISTRIBUTION: ? Mexico, Costa Rica and Panama.

### ***Proceratium mexicanum* de Andrade n. sp.**

Figs. 71, 72, 73

*Proceratium micrommatum* (Roger), Brown, 1958a: 242 fig. 28, 248 (distribution in S. Mexico), 333 (localities: Chichicastle, Tabasco; Pueblo Nuevo, near Tetzonapa; Vera Cruz). Partim. Misidentification.

*Proceratium micrommatum* (Roger), Brown, 1974: 82 (material from Mexico: Chichicastle (Tabasco), Pueblo Nuevo, Vera Cruz and Antiguo-Morelos). Misidentification.

?*Proceratium micrommatum* (Roger), Ward, 1988: 115. Male. Texas.

TYPE MATERIAL: holotype worker from Mexico labelled: "Mex.: Tamps.; Antiguo Morelos, 9.vii.1969, S. & J. Peck, Ber 167, palm-thorn for. litter"; 4 paratype workers, same data as the holotype, holotype in MCZC, paratypes in MCZC and MZSP.

DERIVATIO NOMINIS: "*mexicanum*" is a neologism indicating the provenance of the species from Mexico.

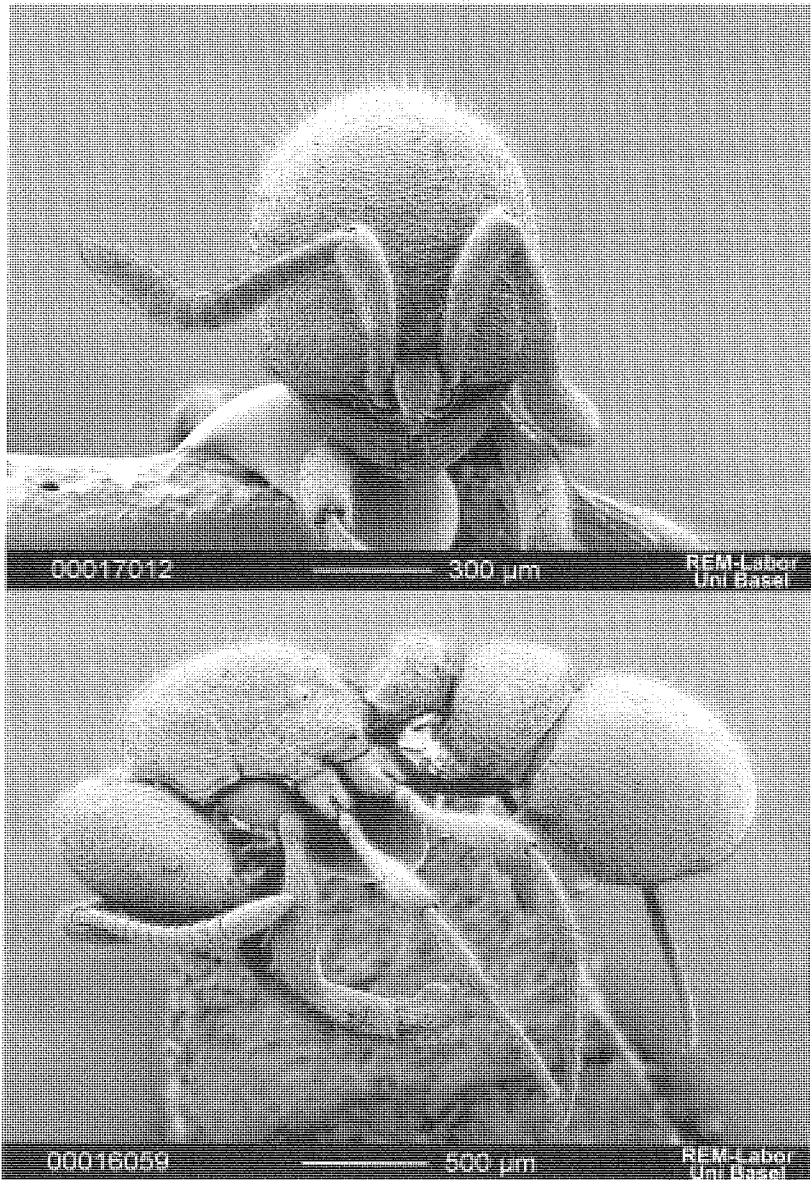


Fig. 71 – *Proceratium mexicanum* de Andrade. Worker from Córdoba, Vera Cruz, Mexico: head (top) in dorsal view and meso- and metasoma (bottom) in side view.

DIAGNOSIS. A *Proceratium* species belonging to the *micrommatum* clade, resembling *convexiceps*, but differing from it in the worker, by the following characters: area between basal and declivous faces of the propodeum with a clear transversal carina (absent or poorly marked only laterally in *micrommatum*), and body sculpture more superficial than in *micrommatum*.

DESCRIPTION. *Worker* (Fig. 71). Head longer than broad, slightly narrower anteriorly than posteriorly. Vertex in full face view weakly convex medially. Clypeus medially reduced, triangular or subround, recognizable between and longer than the antennal sockets. Antennal socket with broad torulus. Frontal carinae close to each other, not covering the antennal insertions. Frontal area behind the frontal carinae weakly convex. Lateral expansions of the frontal carinae relatively narrow, raised and gently diverging posteriorly. Genal carinae present and well marked. A superficial sulcus between the genal carinae and the gular area. Eyes composed by a small convex facet below the midline of the head. Scapes thicker in the distal half and far short of the vertexal margin. First funicular joint 1/3 longer than broad. Funicular joints 2-10 broader than long. Last funicular joint as long as the sum of joints 6-10. Mandibles with 3 denticles before the apical tooth. Palp formula 3,2.

Mesosoma gently convex in side view. Promesonotal and propodeal sutures absent. Promesopleural and mesometapleural sutures impressed on the ventral half only. Basal face of the propodeum gently convex or declivous posteriorly and with traces of a superficial, transverse sulcus close to the declivous face; the sulcus postero-laterally strongly carinate; in some specimens the carina transformed in a tooth on each side between the basal and declivous face. Declivous face of the propodeum with the sides superficially marginate, the margin variably crenulate. Propodeal lobes subround or truncate and with variably crenulate margin. Propodeal spiracles small and tumuliform.

Petiole slightly longer than or as long as broad. Petiole in dorsal view with the sides subparallel in the anterior fourth and convex posteriorly. Anterior border of the petiole straight or gently concave and carinate. Ventral process of the petiole subtriangular and small. Postpetiole slightly less than 1/2 of the length of the gastral tergite I (LT4). Postpetiole in dorsal view anterolaterally subround and with the sides convex. Postpetiolar dorsum with

a swelling close to the posterior border. Postpetiolar sternite anteromedially with a marked subtriangular projection. Posterior half of the postpetiolar sternite straight or slightly convex. Constriction between postpetiole and gastral segment I deeply impressed. Gastral tergite I strongly convex on the curvature. Gastral sternite I very short medially. Sides of gastral sternite I variably protruding anteriorly, obtuse or round. Remaining gastral tergites and sternites curved ventrally.

Legs slightly elongate. Mid tibiae without spur. Spurs of fore legs without a basal spine. Fore basitarsi longer than the mid ones. Hind basitarsi about 1/4 shorter than hind tibiae. Second tarsomere of mid and hind legs longer than third and fourth tarsomeres, and slightly shorter than pretarsus. Fourth tarsomere of fore legs much longer than tarsomeres 1-3 and shorter than the sum of tarsomeres 1-2. Pretarsal claws simple. Arolia small.

Sculpture. Head, mesosoma, petiole and postpetiole reticulate-punctate and granulate, the granules very sparse on the head and mesosoma, denser and larger on the petiole and postpetiole. Mesosoma, petiole and postpetiole with additional irregular foveae, the foveae superficial, rare and small on the mesosoma, deeper and more numerous on the petiole and postpetiole. First gastral tergite smooth and with minute, sparse piligerous punctures, the punctures denser, larger and mixed with reticulation on its sides and on the posterior border. Legs and antennae superficially granulate-punctate.

Body covered by hairs of three main types: (1) short, dense, subdecumbent on the whole body; (2) long, suberect and sparse on the whole body, absent from the funiculi; (3) shorter than hair type (1), dense, decumbent on the funicular joints only. In addition the funicular joints bear whitish, thick, appressed, sparse hairs and also suberect, hairs similar to type (1).

Colour dark ferruginous or dark brown with lighter antennae and legs.

Measurements in mm and Indices: TL 2.93-4.00; HL 0.71-0.91; HW 0.64-0.81; EL 0.05-0.06; SL 0.45-0.59; WL 0.81-1.10; PeL 0.31-0.40; PeW 0.27-0.41; HFeL 0.55-0.73; HTiL 0.43-0.60; HBaL 0.33-0.50; LS4 0.13-0.19; LT4 0.66-0.98; CI 89.0-92.9; SI 62.5-64.8; IGR 0.19-0.21.

*Gyne*. Differing from the worker in the following details: eyes large, about 1/4 of the head length and with ocular pilosity. Ocelli well developed. Funicular joints more elongate.

Mesosoma robust and convex in side view. Parapsidal furrows superfi-

cially marked. Scutellum with the sides converging posteriorly and with the posterior border rounded or subtruncate. Metanotum without tooth or spine-like projection. Basal face of the propodeum short, laterally variably carinate and angulate, medially incised and as flat as the declivous face.

Petiole about as broad as long.

Sculpture. Granules and foveae rarer and smaller on the mesosoma and on the postpetiole.

Measurements in mm and Indices: TL 3.76-3.90; HL 0.80-0.83; HW 0.73-0.77; EL 0.20; SL 0.54-0.58; WL 1.08-1.16; PeL 0.33-0.35; PeW 0.32-0.35; HFeL 0.68-0.70; HTiL 0.54-0.55; HBaL 0.44-0.47; LS4 0.17-0.18; LT4 0.92-0.94; CI 89.0-92.0; SI 68.3-70.0; IGR 0.18-0.19.

*Male* (Fig. 72) (tentative attribution). Head longer than broad. Vertex in full face view convex. Vertexal margin weakly carinate. Clypeus medially extremely reduced, subround, between and about as long as the antennal socket. Antennal socket with broad torulus. Frontal carinae thin, low and diverging posteriorly. Anterior half of the frontal area gently convex and with a variably impressed longitudinal carina, the second half concave. Ocelli large. Compound eyes slightly less than half of the head length, placed largely on the anterior head sides and with ocular pilosity. Scapes reaching the anterior ocellus. First funicular joint broader than the second joint and slightly broader than half of its length. Funicular joints 1-9 about one half longer than broad; joints 10-12 absent. Mandibles elongate, edentate and only with a pointed apical tooth. Palp formula apparently 3,2.

Mesosoma robust. Pronotum perpendicular to the mesonotum. Mesonotum gently convex. Parapsidal furrows marked. Scutellum as high as the mesonotum and in full dorsal view with the posterior border round. Propodeum with distinct basal and declivous faces. Basal face of the propodeum in dorsal view flat, medially sulcate and laterally subangulate. Declivous face of the propodeum perpendicular to the basal face. Metanotum without median spine-like projection. Propodeal lobes small and subround. Propodeal spiracles small and weakly oriented downwards.

Petiole in profile declivous on the anterior half and strongly convex on the posterior half. Petiole in dorsal view with diverging sides in the anterior third and strongly convex in the two posterior thirds. Anterior border of the petiole concave and carinate. Subpetiolar process in shape of a subtriangular, longitudinal lamella. Postpetiole in side view convex. Postpetiole ante-

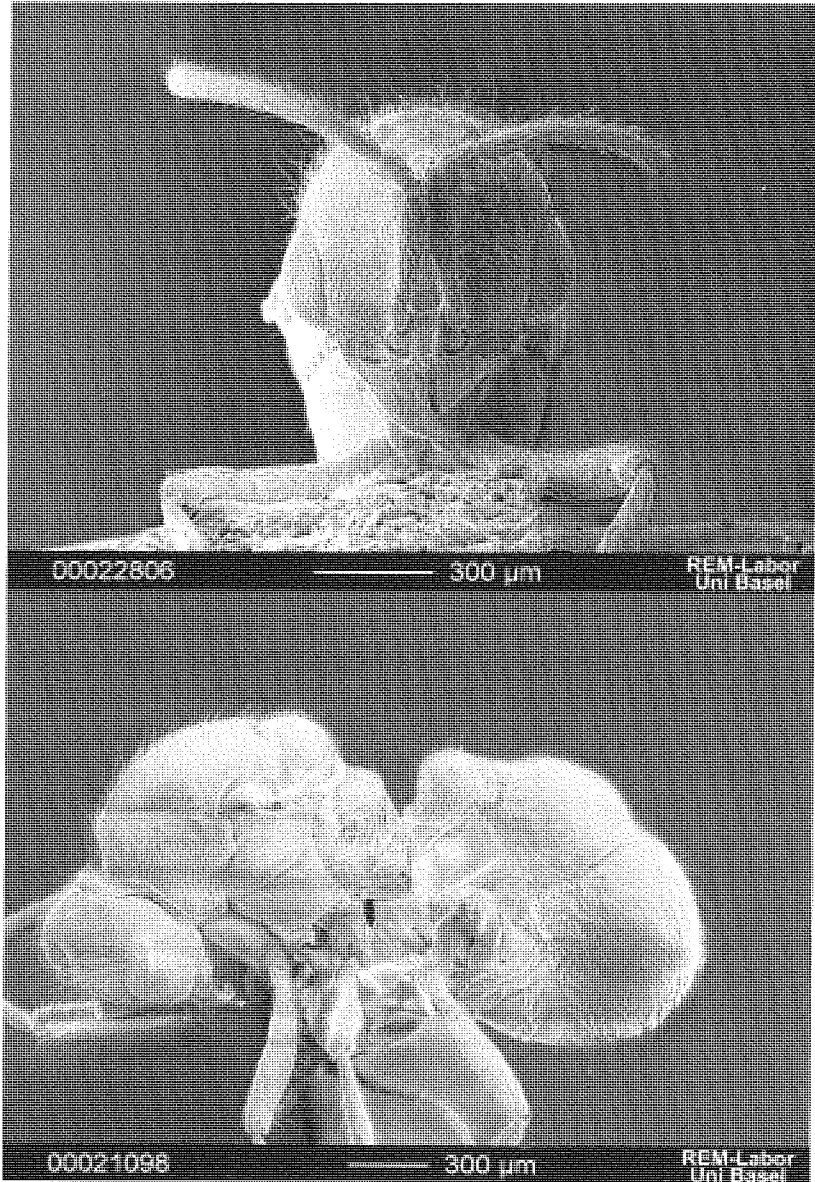


Fig. 72 – *Proceratium mexicanum* de Andrade. Male from El Bonito, San Luis Potosí, Mexico: head (top) in dorsal view and meso- and metasoma (bottom) in side view.



riorly broader than the petiole; postpetiolar sides convex. Anterior border of the postpetiolar sternite with a projecting triangular "lip". Gastral tergite I round. Gastral sternite I broad in the middle. Remaining gastral tergites and sternites curved ventrally.

Legs less elongate than in *convexiceps*. Hind basitarsi shorter than hind tibiae. Genitalia as in Fig. 73.

Sculpture. Head, pronotum, mesonotum, scutellum, mesopleurae, petiole, postpetiole, gaster and legs with small piligerous foveae, the foveae more impressed on the two anterior thirds of the cephalic capsule. In addition the petiole and the postpetiole with very sparse, minute granulation. Propleurae sculptured as the pronotum but with few, very thin, rugosities. Propodeum with dense, irregular impressions or small foveae. Metapleurae with thick, irregular rugosities.

Body covered by hairs of three main types: (1) short, dense, subdecumbent on the whole body, suberect and sparser on the funicular joints; (2) long, suberect and sparse on the whole body, slightly longer on the petiole, postpetiole and gaster, absent from the antennae; (3) shorter than hair type (1), dense, decumbent on the funicular joints only. In addition the funicular joints bear whitish, thick, appressed, short, sparse hairs and the scapes with hairs similar to type (1) but longer.

Colour. Light brown.

Measurements in mm and Indices: TL 3.57; HL 0.67; HW 0.61; EL 0.28; SL 0.48; WL 1.16; PeL 0.36; PeW 0.31; HFeL 0.82; HTiL 0.65; HBaL 0.57; LS4 0.29; LT4 0.78; CI 91.0; SI 71.6; IGR 0.37.

MATERIAL EXAMINED: MEXICO: NUEVO LEÓN: near Monterrey, Mesa de Chipinque, 1645 m, 22.VI.1969, 1 worker, S. & J. Peck [MCZC]; same locality and collectors, 1969, 1 worker [MCZC]; Monterrey, 16.XI.1987, 1 gyne, D. González [WEMC]. TAMAULIPAS: Antiguo-Morelos, 9.VII.1969, palm-thorn forest litter, 5 workers (holotype and paratypes), S. & J. Peck [MCZC, MZSP]. SAN LUIS POTOSÍ: El Salto, 3 workers, S. Peck [MZSP]; same locality, 6.VII.1969, 4 workers S. & J. Peck [MCZC]; El Bonito, 7 mi S of Ciudad Valles, elevation 300', 20.XII.1970, 1 gyne, 1 male, P. H. & M. Arnaud [CASC]. VERA CRUZ: Pueblo Nuevo, near Tetzonapa, 18.VIII.1953, tropical evergreen forest, 1 worker, E. O. Wilson [MCZC]; Canyon Río Metlac near Fortin, 3200 ft, 28.VII-1.VIII.1973, leaf litter forest floor, 1 worker, A. Newton [MCZC]; Córdoba, 4.VIII.1969, tropical

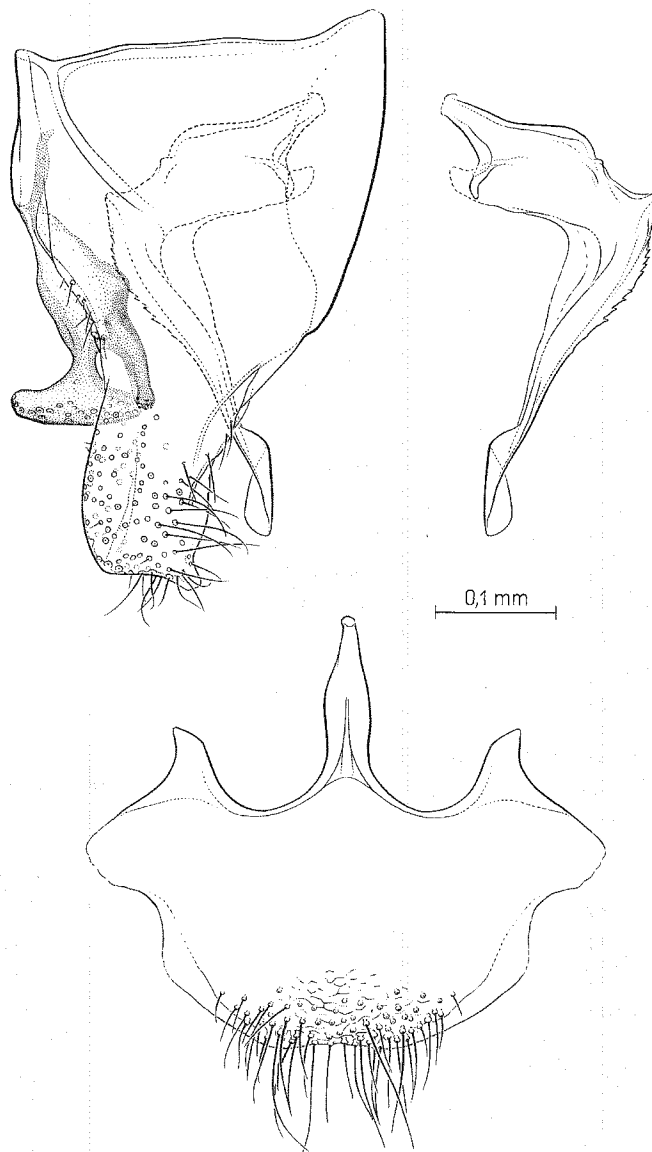


Fig. 73 – *Proceratium mexicanum* de Andrade. Male from El Bonito, San Luis Potosí, Mexico. Genital appendages: a) lateral view of left parameres and of their relative positions; b) right aedeagus in profile; c) subgenital plate in ventral view.

evergreen forest, 1 worker, S. & J. Peck [MCZC]; Córdoba, Paraje Nuevo, Nacimiento, 7.VIII.1969, trop. everg. for., 2 workers, S. & J. Peck [MCZC]. OAXACA: 9 mi E El Cameron, 4300 ft, pine-oak, 23.VIII-6.IX.1973, 1 worker, A. Newton [MCZC]; 15 mi S Valle Nacional, 4000 ft, 21.V.1971, 2 workers, S. Peck [MCZC, MZSP]. TABASCO: Chichicastle, 16.VIII.1945, 1 gyne, F. Bonet [MCZC]. CHIAPAS: 12 mi NW Ocozocoautla, 3200 ft, 4-5.IX.1973, leaf litter forest floor, 2 workers, 1 gyne, A. Newton [MCZC]; Ocosingo, 2.VI.1969, 1 worker, J. M. Campbell [MCZC].

DISCUSSION. *P. mexicanum* is very similar to *convexiceps* but *mexicanum* has each side between the basal and declivous faces of the propodeum strongly carinate and the body sculpture less impressed.

The two workers from Oaxaca (Valle Nacional) differ from the other workers by the stouter body (TL 3.75 mm), by the basal face of the propodeum more convex, by the propodeal carina ticker and by the massive petiole (PeL 0.40 mm, PeW 0.40-0.41 mm).

The two workers from Mesa de Chipinque are very large (TL 3.80-4.00 mm) and have the petiole (PeL 0.38-0.39 mm, PeW 0.39 mm) similar to the workers from Valle Nacional.

The worker from Ocosingo has the hairs slightly longer than the other specimens.

The gyne from El Bonito differs from the other gynes by the hairs longer, resembling the hairs of the worker from Ocosingo.

Ward, 1988 attributed a male from south Texas (Hidalgo County) to *micrommatum* or to the *micrommatum* complex. He added that this male is relatively small (HW 0.66 mm), with strongly recurved gaster (IGR 0.32) and mid tibiae without spur. We examined *mexicanum* workers from Monterrey (ca. 220 km from the locality of the Texan male studied by Ward). The male from El Bonito (San Luis Potosí) here tentatively attributed to *mexicanum* differs from Ward's male in the following: HW 0.61 mm instead of 0.66 mm, IGR 0.32 instead of 0.37. We did not see the specimen in question but it might belong to *mexicanum*.

If our interpretation of *mexicanum* is correct, a certain amount of geographic variability should characterize this species. We can not exclude, however, that the collection of additional material might allow the separation of one or more species from it.

DISTRIBUTION: Mexico.

**Proceratium panamense** de Andrade n. sp.

Figs. 74, 75, 76, 77

TYPE MATERIAL: holotype worker from Panama labelled: "Boquete, 15 June, 1978, G. J. Umphrey", in MCZC; paratypes: 6 workers and 1 gyne same data as the holotype, MCZC and MIZA; 4 workers same data as the holotype and paratypes except the date, 16 June, MCZC.

DERIVATIO NOMINIS: "*panamense*" is a neologism indicating the provenance of the species from Panama.

DIAGNOSIS. A *Proceratium* species belonging to the *micrommatum* clade and resembling *micrommatum*, but differing from it in the worker and gyne, by the larger size (worker TL  $\geq 3.80$  mm instead of TL  $< 3.60$  mm, and gyne TL = 4.57 mm instead of TL  $< 3.60$  mm), and by the SI ( $\leq 60.8$  in *panamense* and  $\geq 61.7$  in *micrommatum*).

DESCRIPTION. *Worker* (Fig. 74). Head longer than broad, slightly narrower anteriorly than posteriorly. Vertex in full face view convex. Clypeus medially extremely reduced, triangular, between and slightly longer than the antennal socket. Antennal socket with broad torulus. Frontal carinae close each other, not covering the antennal insertions. Frontal area behind the frontal carinae gently tumuliform. Lateral expansions of the frontal carinae relatively narrow, raised, diverging or subparallel. Genal carinae poorly marked. A superficial sulcus is present between the genal carinae and the gular area. Eyes composed by a clear convex facet, and placed below the mid line of the head. Scapes thicker in the posterior half and short of the vertexal margin. First funicular joint 1/3 longer than broad. Funicular joints 2-10 broader than long. Last funicular joint as long as the sum of joints 6-10. Mandibles each with 3 denticles before the apical tooth. Palp formula probably 3,2.

Mesosoma slightly convex in side view. Promesonotal and propodeal sutures absent. Promesopleural and mesometapleural sutures impressed on the ventral half only. Basal face of the propodeum gently declivous and with a very superficial, transversal sulcus close to the declivous face, in some specimens the sulcus interrupted medially. Declivous face of the propodeum with the sides superficially marginate, the margin more marked posteriorly. Propodeal lobes subround and with variably crenulate margin. Propodeal spiracles small and tumuliform.

Petiole slightly longer than broad. Petiole in dorsal view with the sides subparallel or diverging in the anterior fourth and convex posteriorly. Anterior border of the petiole concave, entirely carinate and angulate on each side. Ventral process of the petiole subtriangular and small. Postpetiole less than 1/2 of the length of the gastral tergite I (LT4), in dorsal view anterolaterally angulate and with the sides weakly convex. Postpetiolar sternite anteromedially with a superficially marked subtriangular projection. Posterior half of the postpetiolar sternite straight or slightly convex. Constriction between postpetiole and gastral segment I deeply impressed. Gastral tergite I strongly round. Gastral sternite I very short medially. Sides of gastral sternite I protruding anteriorly, obtuse and carinate. Remaining gastral tergites and sternites curved ventrally. Sting developed.

Legs slightly elongate. Mid tibiae without spur. Spurs of fore legs without a basal spine. Fore basitarsi longer than the mid ones. Hind basitarsi about 1/5 shorter than hind tibiae. Second tarsomere of mid and hind legs longer than third and fourth tarsomeres, and slightly shorter than pretarsus. Pretarsal claws simple. Pretarsal arolia very small.

Sculpture. Head, mesosoma, petiole and postpetiole granulopunctate. Petiole and postpetiole with additional superficial and small, irregular depressions like foveae. On the petiole and postpetiole some granule raised as small peaks. Gaster smooth and with minute, sparse piligerous depressions. Some specimens have the anterior and posterior border of the gaster granulate. Legs and antennae superficially granulate-punctate.

Body covered by hairs of three main types: (1) short, dense, subdecumbent on the whole body; (2) long, suberect, slightly recurved and relatively dense on the whole body, absent from the funiculi; (3) shorter than hair type (1), dense, decumbent on the funicular joints only. In addition the funicular joints bear whitish, thick, appressed, sparse hairs and also suberect, hairs similar to type (1).

Colour ferruginous or dark brown with antennae and legs lighter.

Measurements in mm and Indices: TL 3.80-4.77; HL 0.89-1.10; HW 0.75-0.96; EL 0.04-0.07; SL 0.53-0.66; WL 1.05-1.30; PeL 0.39-0.50; PeW 0.36-0.45; HFel 0.68-0.87; HTiL 0.52-0.72; HBaL 0.40-0.53; LS4 0.13-0.17; LT4 0.91-1.20; CI 82.0-87.3; SI 57.0-60.8; IGR 0.13-0.16.

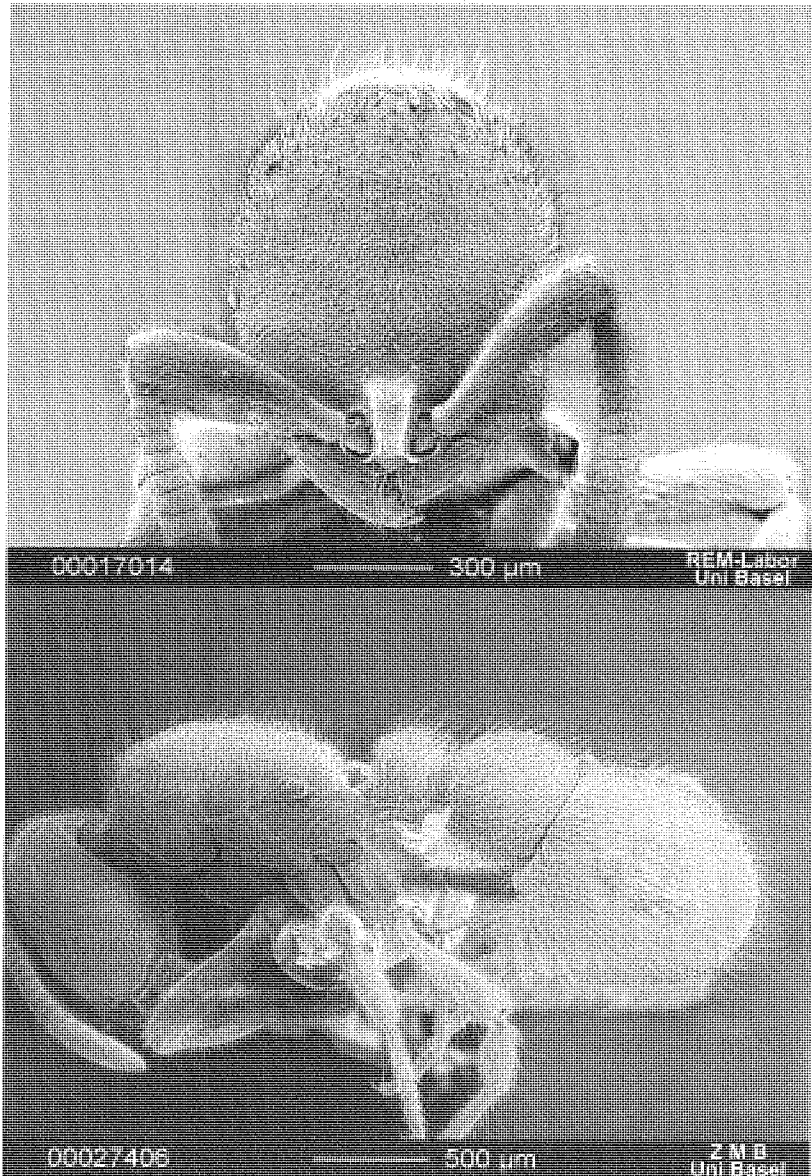


Fig. 74 – *Proceratium panamense* de Andrade. Worker (paratype) from Boquete, Panama: head (top) in dorsal view and meso- and metasoma (bottom) in side view.

*Gyne* (description based on a single specimen) differing from the worker in the following details: eyes large, about 1/4 of the head length and with ocular pilosity. Ocelli well developed.

Mesosoma robust and convex in side view. Parapsidal furrows superficially marked. Scutellum with the sides converging posteriorly and with the posterior border rounded. Metanotum without tooth or spine-like projection. Basal face of the propodeum very short, weakly angulate on each side, medially incised and as flat as the declivous face.

Sculpture. Mesonotum with piligerous punctures and smooth. Gastral tergite I with small piligerous punctures only.

Colour dark ferrugineous.

Measurements in mm and Indices: TL 4.57; HL 0.95; HW 0.80; EL 0.24; SL 0.57; WL 1.30; PeL 0.44; PeW 0.40; HFeL 0.78; HTiL 0.58; HBaL 0.47; LS4 0.16; LT4 1.20; CI 84.2; SI 60.0; IGR 0.13.

*Male* (Fig. 75) (tentative attribution). Head longer than broad. Vertex in full face view convex. Vertexal margin carinate. Clypeus medially reduced, subtriangular, between and slightly longer than the antennal socket. Antennal socket with broad torulus. Frontal carinae thin, low, diverging posteriorly and separated each other. Anterior half of the floor of the frontal carinae gently convex and the second half concave. Area behind the frontal carina convex and with a median longitudinal carina. Ocelli large. Compound eyes slightly more than 1/3 of the head length, placed largely on the anterior head sides and with ocular pilosity. Scapes shortly surpassing the vertex. First funicular joint about 1/3 longer than broad, thicker and about as long as the second joint. Funicular joints 2-11 about 1/2 longer than broad. Last funicular joint slightly shorter than the sum of joints 9-11. Mandibles elongate, edentate and only with a pointed apical tooth. Palp formula 3,2.

Mesosoma robust. Pronotum perpendicular to the mesonotum. Mesonotum convex. Parapsidal furrows marked. Scutellum as high as the mesonotum and in full dorsal view with the posterior border round. Propodeum in side view weakly convex and sloping posteriorly, basal and declivous faces not clearly separated. Metanotum without a median spine like projection. Propodeal lobes round.

Petiole in side view declivous on the anterior third and convex on the two posterior thirds. Petiole in dorsal view with parallel sides in the anterior third, the remaining two posterior thirds gently convex anteriorly and paral-

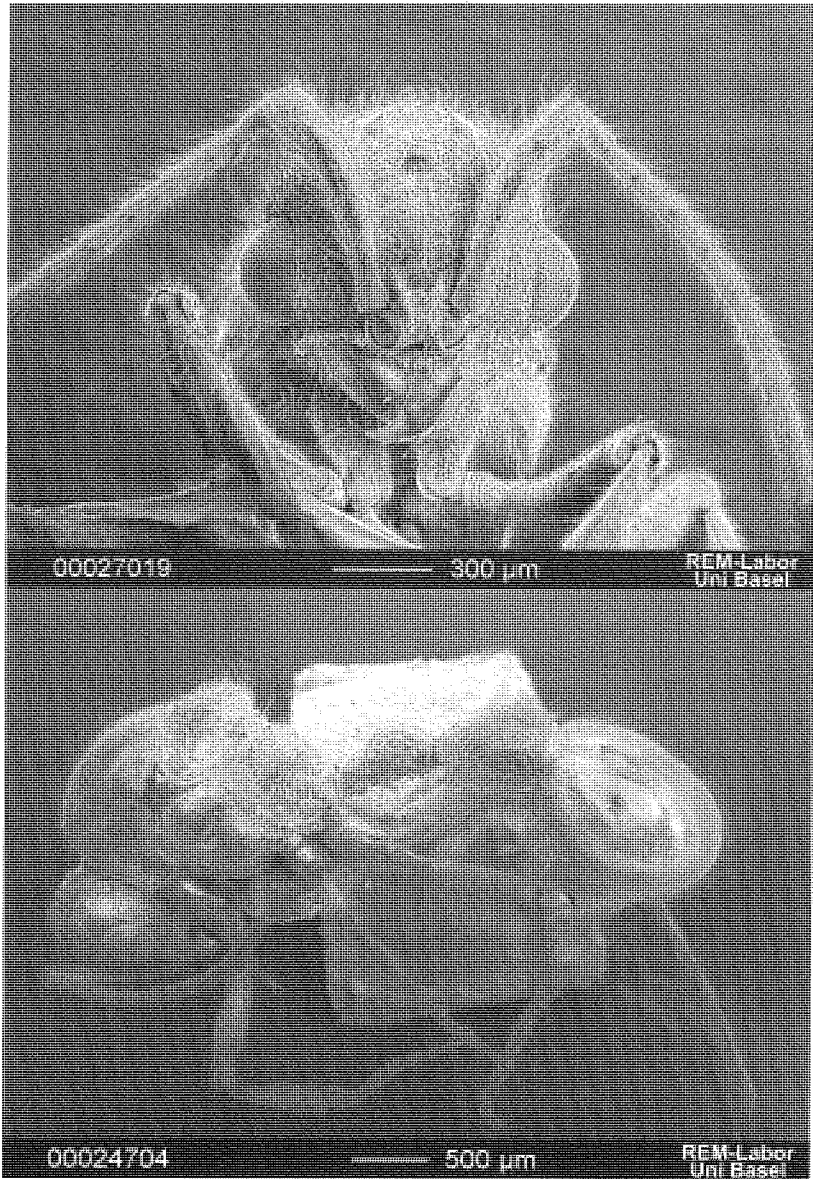


Fig. 75 – *Proceratium panamense* de Andrade. Male from Zurqui, Heredia, Costa Rica: head (top) in dorsal view and meso- and metasoma (bottom) in side view.



lel posteriorly. Anterior border of the petiole concave, superficially carinate and laterally denticulate. Subpetiolar process small and subtriangular. Postpetiole weakly convex in side view. Postpetiole anteriorly about as broad as the petiole; postpetiolar sides anteriorly diverging and gently convex posteriorly. Anterior border of the postpetiolar sternite with a projecting triangular "lip". Gastral tergite I round. Gastral sternite I broad in the middle. Remaining gastral tergites and sternites curved ventrally.

Legs elongate. Hind basitarsi as long as the hind tibiae.

Fore wings of our type 5, hind wings of our type 3 as defined in the description of the genus (Fig. 76).

Genitalia as in Fig. 77.

Sculpture. Head, pronotum, mesonotum, pro- and mesopleurae, and scutellum granulate and with rare, thin, rugosities, the granulation sparser and smaller on the dorsum of the pronotum and center of the anterior half of the mesonotum, larger on the scutellum. Scutellum with additional superficial impressions resembling foveae. Propodeum and metapleurae with dense irregular impressions like irregular rugosities and impressions resembling foveae. Petiole granulate-foveolate, this sculpture rare on center of the node. Postpetiole granulate, the granulation sparser and more superficial on its dorsum. First gastral tergite with minute piligerous; sides and posterior border of the first gastral tergite granulate. Legs minutely punctate.

Pilosity similar to the male of *convexiceps*.

Colour. Dark brown-black with slightly lighter funicular joints, tibiae, tarsi and tarsomeres.

Measurements in mm and Indices: TL 5.30; HL 0.88; HW 0.78; EL 0.32; SL 0.69; WL 1.74; PeL 0.61; PeW 0.38; HFeL 1.32; HTiL 0.92; HBaL 0.92; LS4 0.44; LT4 1.24; CI 88.6; SI 78.4; IGR 0.35.

MATERIAL EXAMINED: COSTA RICA: Alajuela Province, 6.5 km E Monteverde, 10°18' N 84°45' W, 950 m, 22.VIII.1985, 1 worker, J. Longino [INBC]; Guanacaste Province, Cacao Field Station, wet mountain forest litter, 15.II.1996, 1 worker, R. Anderson [WEMC]; Puntarenas, 5 Km SW, Est. Biol. Las Cruces, 08° 46' 59 N 82° 59' 16 W, wet cloud forest litter, 22.VI.1988, 1 worker, R. Anderson [WEMC]; Zurqui, 1600 m, 1-9.IX.1998, 1 male, C. & L. O'Brien [MCZC]; Province Heredia, 16 km SSE La Virgen, 1050-1150 m, 10°16' N 84°05' W, 22.III.2001, 1 worker, INBio-OET-ALAS transect [INBC]. PANAMA: Boquete, 15.VI.1978,

1 worker (holotype) [MCZC], 15 & 16.VI.1978, 10 workers, 1 gyne (paratypes), G. J. Umphrey [MCZC, MIZA]; Chiriqui, 24 km W El Hato del Volcán, 3800', berlese cloud forest leaf litter, 26-27.VI.1976, 1 worker, A. Newton [MCZC]; Chiriqui, Volcán Hartman's, Finca, cloud forest litter, 16.VI.1995, 1 worker, R. Anderson [WEMC].

DISCUSSION. As already mentioned in the diagnosis *panamense* resembles *micrommatum*. Both species have the first gastral sternite strongly triangular and protruding anteriorly. *Panamense* also share with *micrommatum* and *poinari* the postpetiole anterolaterally slightly angulate. These characters were not used in our analysis because some other species of the *micrommatum* clade may have postpetiole anterolaterally weakly angulate and the first gastral sternite variably triangular and protruding anteriorly.

DISTRIBUTION: Costa Rica and Panama.

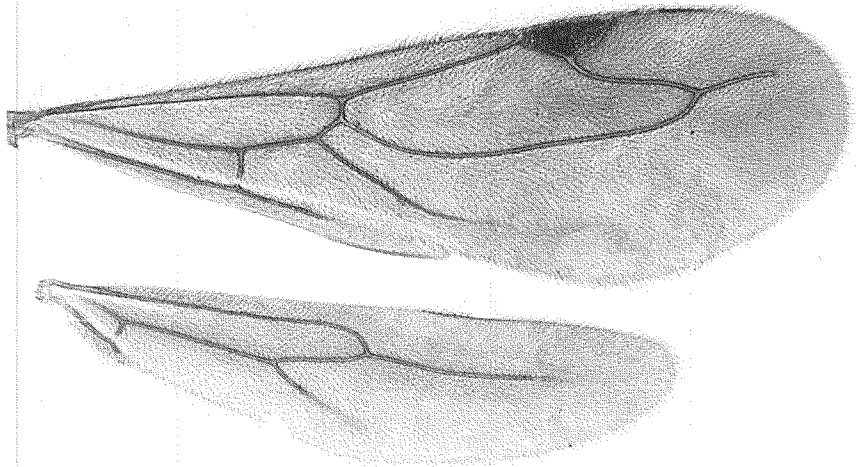


Fig. 76 – *Proceratium panamense* de Andrade. Male from Zurqui, Heredia, Costa Rica: fore and hind wings.

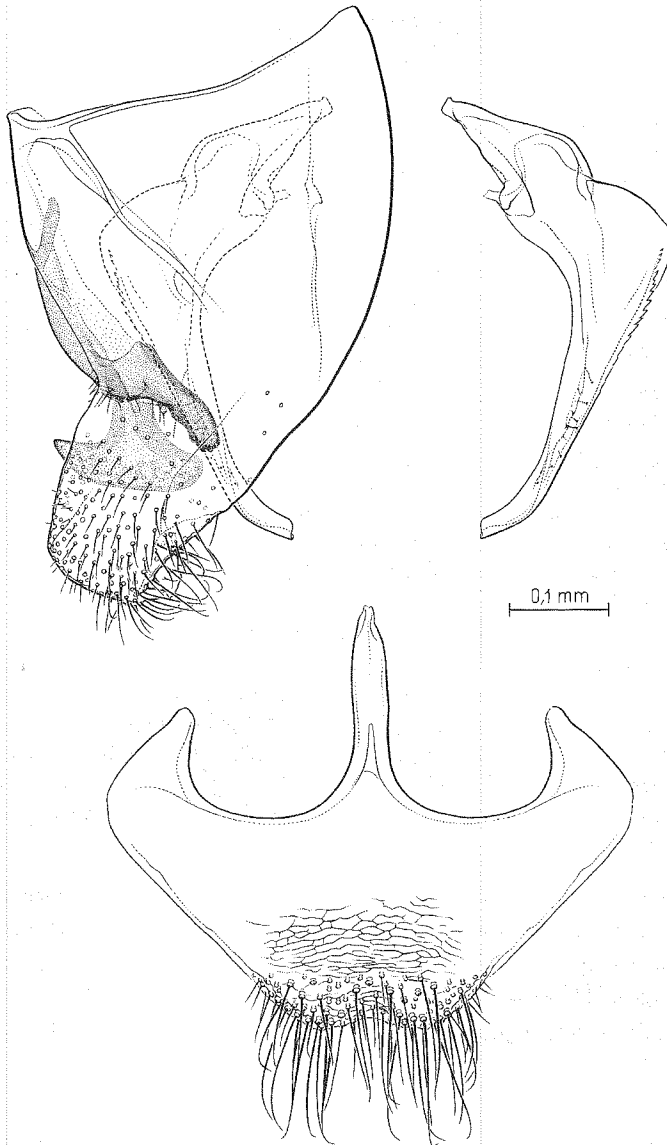


Fig. 77 — *Proceratium panamense* de Andrade. Male from Zurqui, Heredia, Costa Rica. Genital appendages: a) lateral view of left parameres and of their relative positions; b) right aedeagus in profile; c) subgenital plate in ventral view.

## **Proceratium micrommatum** (Roger)

Figs. 78, 79

*Sysphincta micrommata* Roger, 1863: 176. Worker. Original description. Type locality: South America. Type material: holotype worker labelled: "Süd-America; *Proceratium micrommatum* (Rog) Em; TYPE; 1895; *Sysphincta* Roger; *micrommata* Roger; Zool. Mus. Berlin", in ZMBC, examined.

*Sysphincta cavernicola* Borgmeier, 1937: 221, figs. 1-4. Gyne. Original description. Type locality: Panama. Type material: holotype gyne labelled: "Chilibrillo Caves, Panama, L. H. Dunn, 1931. C-99; Typus; Holotypus; *Sysphincta cavernicola* Holotype, det. Borgmeier; *Proceratium micrommatum* (Roger), det. W. L. Brown", in MZSP, examined. Synonymy by Borgmeier, 1957: 118. Gyne only. The "*micrommatum*" worker in this paper refers to *cubanum* (q. v.). Partim.

*Proceratium micrommatum* (Roger), Dalla Torre, 1893: 18. First combination in *Proceratium*.

*Proceratium micrommatum* (Roger), Forel, 1895: 111.

*Proceratium micrommatum* (Roger), Brown, 1958a. Partim. Nec Roger, 1863. Misidentification. Pages 242, fig. 28 (*mexicanum*), 248 (distribution in S. Mexico = *mexicanum*) & 333 (material from Mexico: Chichicastle (Tabasco), Pueblo Nuevo (near Tetzonapa) and Vera Cruz = *mexicanum*).

*Proceratium micrommatum* (Roger), Snelling, 1967: 9 (identification key).

*Proceratium micrommatum* (Roger), Brown, 1980: 343. Nec Roger, 1863. Material from Mexico *mexicanum*; material from Ecuador probably *ecuadoriense*. Partim. Misidentification.

*Proceratium micrommatum* (Roger), Ward, 1988: 115 ?Male from Texas; 117 (identification key; material from Antilles (examined) = *taino*, from Ecuador probably *ecuadoriense*. Partim. Misidentification?

*Proceratium micrommatum*, Kugler, 1991: 158, figs. 35-38. Worker, sting apparatus.

**DIAGNOSIS.** A *Proceratium* species belonging to the *micrommatum* clade, similar to *panamense* and *poinari*, but differing from *panamense*, in the worker and gyne, by the smaller size (worker TL < 3.60 mm instead of  $\geq$  3.80 mm, gyne TL < 3.60 mm instead of 4.57 mm) and by the SI  $\geq$  61.7 instead of  $\leq$  60.8; and from *poinari* by the worker and gyne IGR  $\leq$  0.16 instead of  $\geq$  0.23.

**DESCRIPTION.** *Worker* (Fig. 78). Head longer than broad, slightly narrower anteriorly than posteriorly. Vertex in full face view straight. Clypeus very reduced, triangular or round, between the and slightly longer than the antennal sockets. Antennal sockets with broad torulus. Frontal carinae close

each other, not covering the antennal insertions. Frontal area behind the frontal carinae weakly convex. Lateral expansions of the frontal carinae relatively narrow, raised, diverging or subparallel. Genal carinae poorly marked. A superficial sulcus between the genal carinae and the gular area. Eyes present, composed by a clearly convex facet placed below the midline of the head. Ocelli absent. Scapes thicker in the distal half and short of the vertexal margin. First funicular joint  $1/3$  longer than broad. Funicular joints 2-10 broader than long. Last funicular joint as long as the sum of joints 6-10. Masticatory margin of the mandibles with 3 denticles before the apical tooth. Palp formula 3,2.

Mesosoma slightly convex in side view. Promesonotal and propodeal sutures absent. Promesopleural and mesometapleural sutures impressed on the ventral half only. Basal face of the propodeum gently declivous or weakly convex, with a superficial trace of a transversal sulcus close to the declivous face; the sulcus sometimes posteriorly carinate. Declivous face of the propodeum with the sides superficially marginate, the margin more marked posteriorly. Propodeal lobes subround and with variably crenulate margin. Propodeal spiracles small and tumuliform.

Petiole as broad as long, in dorsal view with the sides subparallel in the anterior fourth or fifth and convex posteriorly. Anterior border of the petiole straight or concave, variably carinate and angulate on each side. Ventral process of the petiole subtriangular and small. Postpetiole less than  $1/2$  of the length of the gastral tergite I (LT4), in dorsal view anterolaterally gently angulate and with the sides weakly convex. Postpetiolar sternite anteromedially with a superficially marked subtriangular projection. Posterior half of the postpetiolar sternite straight or slightly convex. Constriction between postpetiole and gastral segment I deeply impressed. Gastral tergite I slightly angulate on the curvature, less round than *panamense*. Gastral sternite I very short medially. Sides of gastral sternite I protruding anteriorly, obtuse and carinate. Remaining gastral tergites and sternites curved ventrally. Sting developed.

Legs moderately elongate. Mid tibiae without spur. Spurs of fore legs without basal spine. Fore basitarsi longer than the mid ones. Hind basitarsi about  $1/5$  shorter than hind tibiae. Second tarsomere of mid and hind legs

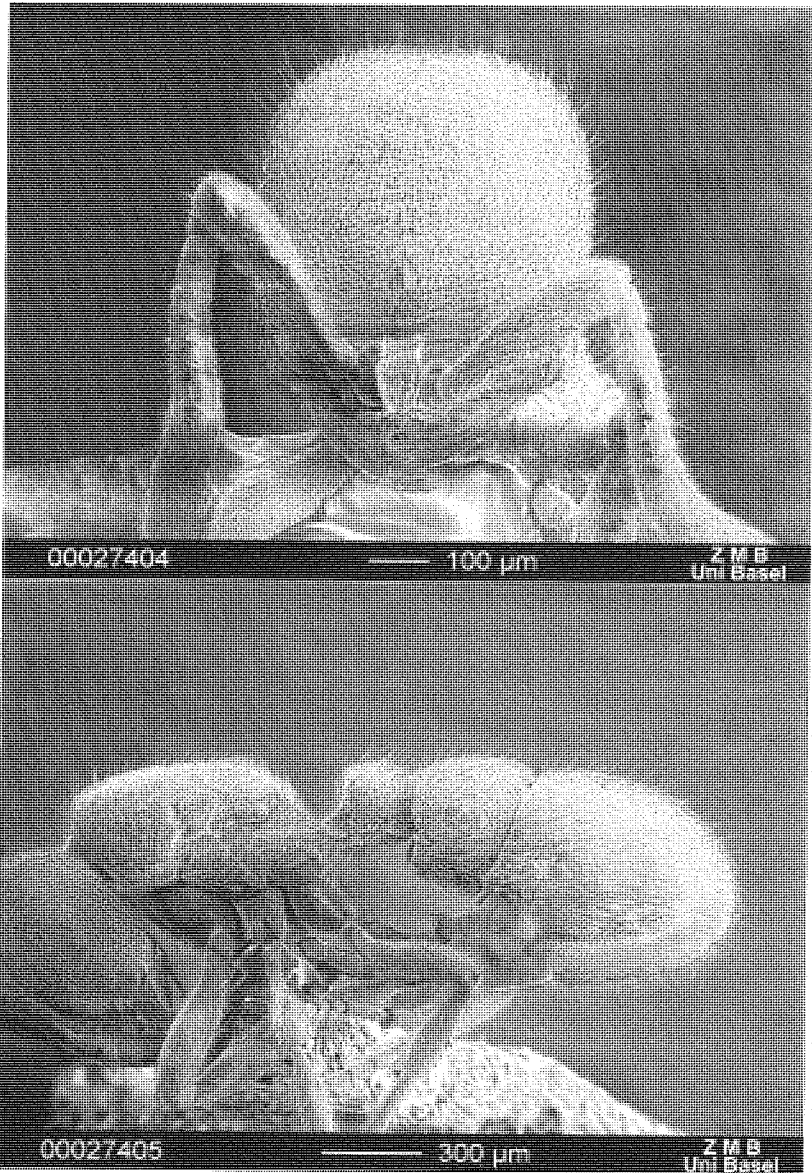


Fig. 78 – *Proceratium micrommatum* (Roger). Worker from Parque Nacional Corcovado, Province Puntarenas, Costa Rica: head (top) in dorsal view and meso- and metasoma (bottom) in side view.

longer than third and fourth tarsomeres, and slightly shorter than pretarsus. Pretarsal claws simple. Arolia very small.

Sculpture. As in *panamense* but the petiole and postpetiole with sparser foveae-like depressions.

Pilosity. As in *panamense* but with hairs of type (2) shorter and less recurved.

Colour light brown-ferrugineous with lighter antennae and legs.

Measurements in mm and Indices: TL 2.64-3.53; HL 0.62-0.81; HW 0.53-0.72; EL 0.04-0.05; SL 0.40-0.50; WL 0.72-0.95; PeL 0.26-0.35; PeW 0.23-0.35; HFeL 0.45-0.61; HTiL 0.37-0.50; HBaL 0.28-0.35; LS4 0.10-0.14; LT4 0.65-0.90; CI 85.5-89.7; SI 61.7-64.5; IGR 0.14-0.16.

*Gyne*. It differs from the worker in the following details: eyes large, shorter than 1/3 of the head length and with ocular pilosity. Ocelli well developed.

Mesosoma robust and convex in profile. Parapsidal furrows weakly impressed. Scutellum with the sides converging posteriorly and with the posterior border round. Metanotum without tooth or spine-like projection. Basal face of the propodeum very short, laterally weakly angulate, medially incised and as flat as the declivous face.

Fore wings of our type 5, hind wings of our type 3 as defined in the description of the genus (Fig. 79).

Sculpture. Mesonotum less granulate and more smooth.

Measurements in mm and Indices: TL 3.25-3.55; HL 0.66-0.71; HW 0.58-0.63; EL 0.18-0.20; SL 0.42-0.45; WL 0.91-1.00; HFeL 0.53-0.56; HTiL 0.42-0.45; HBaL 0.32-0.35; LS4 0.13-0.16; LT4 0.89-0.98; CI 86.6-89.3; SI 63.3-64.5; IGR 0.15-0.16.

MATERIAL EXAMINED: South America (no further locality), 1 worker (holotype of *Sysphincta micrommata*) [ZMBC]. HONDURAS: Lancetilla near Tela, 19-21.III.1979, wet lowland forest, 6 workers, 1 gyne, W. L. Brown [MCZC]. COSTA RICA: San José, 1.I.1943, 1 gyne, H. Schmidt [MZSP]; La Selva, Province Heredia, VI.1974, leaf litter Berlese in cacao plantation, 2 workers, Talbot & VanDevender [LACM]; Est. Biol. La Selva, Province Heredia, 50-150 m, 10°26' N 84°01' W, XI.1992, 1 worker, IN-Bio-OET [INBC]; La Selva, Province Heredia, in rotten log in light gap, 3.I.1999, 1 gyne, L. R. Davis [MCZC]; P. N. Manuel Antonio, Province

Puntarenas, 9°23' N 84°09' W, < 40 m, 27-28.VII.1985, 1 gyne, J. Longino [INBC]; Osa Peninsula, Corcovado, Río Pavo, 16.VII.1982, 1 gyne, J. Longino [INBC]; same locality, Sirena, 8°28' N 83°35' W, 0-100 m, 11.VII.1982, 1 worker, J. Longino [INBC]; Par. Nac. Corcovado, Province Puntarenas, 8°29' N 83°36' W, < 100 m, 18.XII.1990, 3 workers, J. Longino [INBC]; Res. Biol. Carara, Province Puntarenas, 9°47' N 84°36' W, 30 m, 23-25.VII.1985, 1 worker, 1 gyne, J. Longino [INBC]. PANAMA: Chilibrillo Caves, 1931, 1 gyne (holotype of *Sysphincta cavernicola*), L. H. Dunn [MZSP]; Cerro Campana, 17.I.1960, 800-950 m, 3 workers, G. B. Fairchild & W. L. Brown [MCZC, MZSP]; Barro Colorado Island, 2 workers [MCZC]; same locality, Canal Zone, 31.VII.1938, 1 worker, E. C. Williams [MCZC]; same locality, 23.V.1956, 1 gyne, Carl W. & Marian E. Rettenmeyer [MCZC]; same locality, 13.II.1976, 6 workers, A. Newton [MCZC]; same locality, June-October 1943, Zetek-5105, Lot. 43-16534, 3

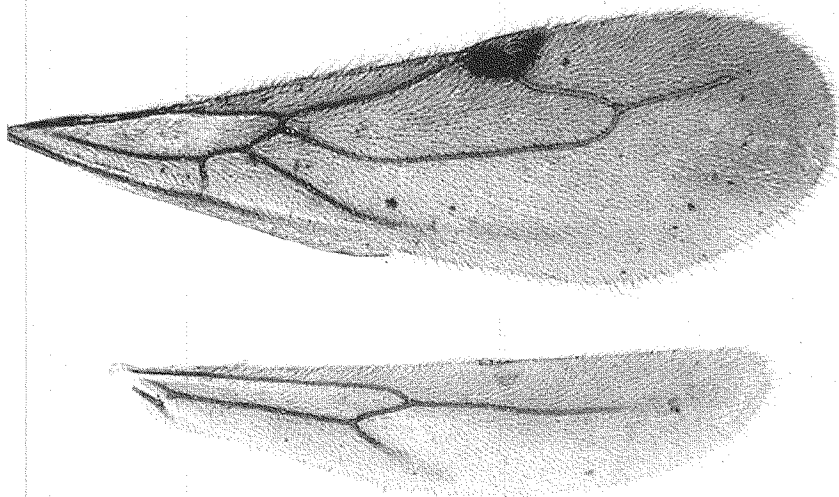


Fig. 79 – *Proceratium micrommatum* (Roger). Gyne from Río Pavo, Corcovado, Costa Rica: fore and hind wings.



workers, 1 gyne [LACM, USNM]; same locality, II.1946-II.1947, Zetek-5272, Lot. 47-4230, 1 worker [USNM]; Gamboa, Soberania National Park, 26.V.1995, 1 gyne, R. Anderson [WEMC]. COLOMBIA: GUAJIRA: R. Don Diego, 25-50 m, 18. VI.1976, forest, 1 gyne, W. L. Brown & R. C. Kugler [MCZC]. VENEZUELA: Zulia: Sierra de Perija, El Tucuco, 450 m, 24.VI.1979, 1 gyne, J. McLaoghlin et al. [MIZA].

DISCUSSION. *Micrommatum* is the most widespread species of its clade. Nonetheless the distribution given in this paper is much narrower than the one resulting from the previous literature. In fact four new species described in this paper have been previously identified as *micrommatum*.

Ward (1988) attributed a male from south Texas (Hidalgo County) to *micrommatum* or to the *micrommatum* complex. He added that the male is relatively small (HW 0.66 mm), with strongly recurved gaster (IGR 0.32) and mid tibia without spur. We did not see the specimen in question but we agree that it should belong to the *micrommatum* clade. It is very likely, however, that this male should be referred to *mexicanum* (q. v.).

Borgmeier (1957) proposed the synonymy of his *Sysphincta cavernicola* Borgmeier with *Proceratium micrommatum* (Roger). We examined the holotype of both species and we confirm the synonymy.

Brown (1974) doubted the specific validity of *convexiceps* Borgmeier. We consider *convexiceps* as a valid species. The reasons for our conclusion are given under the discussion of *convexiceps*.

The identification keys by Brown (1980) and by Ward (1989) list the presence of *micrommatum* also in Ecuador. The only specimens from Ecuador belonging to the *micrommatum* clade that we examined represent a new species described in this paper as *ecuadoriense*.

DISTRIBUTION: Honduras, Costa Rica, Panama, Colombia, Venezuela, Texas?, Ecuador?

† **Proceratium poinari** Baroni Urbani & de Andrade n. sp.

Figs. 7, 8, 9, 10, 15, 16, 17, 18, 19, 20, 21, 22, 23, 25

TYPE MATERIAL: holotype worker in the amber sample H 10-156 K-1 in GOPC; 1 paratype worker in the amber sample H 10-156 K-2, same collection as the holotype.

DERIVATIO NOMINIS: this species is named after Dr. George O. Poinar, Jr. who offered us these and many other important amber specimens in study and allowed us to retain them for years.

DIAGNOSIS. A *Proceratium* species belonging to the *micrommatum* clade and resembling *micrommatum* but differing from it, in the worker and gyne, by the  $IGR \geq 0.23$  instead of  $\leq 0.16$ .

DESCRIPTION. *Worker* (Fig. 9). Head slightly longer than broad, narrower anteriorly than posteriorly. Vertex in full face view gently convex. Clypeus reduced, triangular, and slightly longer than the antennal sockets. Antennal socket with broad torulus. Frontal carinae close to each other, not covering the antennal insertions. Frontal area behind the frontal carinae weakly convex. Lateral expansions of the frontal carinae relatively narrow, raised and diverging. Genal carinae poorly marked. A superficial sulcus between the genal carinae and the gular area. Eyes composed by a clearly convex facet, and placed below the midline of the head. Scapes thicker in the distal half and short of the vertexal margin. First funicular joint  $1/3$  longer than broad. Funicular joints 2-10 broader than long. Last funicular joint about as long as the sum of joints 6-10. Mandibles with 3 denticles before the apical tooth. Palp formula probably 3,2.

Mesosoma slightly convex in profile. Promesonotal and propodeal sutures obsolete. Promesopleural and mesometapleural sutures impressed on the ventral half only. Basal face of the propodeum gently declivous or convex and with a superficial, transversal sulcus close to the declivous face; the sulcus posteriorly strongly carinate and denticulate laterally. Declivous face of the propodeum with crenulate sides. Propodeal lobes obtuse and with crenulate margin. Propodeal spiracles small and projecting.

Petiole longer than broad, with the sides subparallel in the anterior third and convex posteriorly in dorsal view. Anterior border of the petiole concave, carinate and angulate on each side. Ventral process of the petiole

small and subtriangular. Postpetiole  $1/2$  or slightly less than  $1/2$  of the length of the gastral tergite I (LT4), in dorsal view anterolaterally angulate and with the sides weakly convex. Postpetiolar sternite anteromedially with a subtriangular projection. Posterior half of the postpetiolar sternite slightly convex. Constriction between postpetiole and gastral segment I deeply impressed. Gastral tergite I slightly angulate on the curvature, more angulate than in *micrommatum*. Gastral sternite I very short medially. Its sides gently protruding anteriorly and slightly obtuse. Remaining gastral tergites and sternites curved ventrally.

Legs moderately elongate. Mid tibiae without spur. Spurs of fore legs without basal spine. Fore basitarsi longer than the mid ones. Hind basitarsi about  $1/5$  shorter than hind tibiae. Second tarsomere of mid and hind legs longer than third and fourth tarsomeres together, and slightly shorter than pretarsus. Pretarsal claws simple. Arolia very small.

Sculpture. Head minutely reticulate, punctate and sparsely granulate. Mesosoma, petiole and postpetiole granulate-punctate and with small, irregular foveae-like depressions. First gastral tergite superficially smooth and minutely punctate; its lateral and ventral parts granulate. Legs punctate.

Body covered by hairs of three main types: (1) short, dense, subdecumbent on the whole body; (2) long, suberect and sparse on the whole body, slightly curved, longer on the petiole, postpetiole and gaster, absent on the funiculi; (3) shorter than hair type (1), dense, decumbent on the funicular joints only. In addition the funicular joints bear whitish, thick, appressed, sparse hairs and suberect hairs similar to type (1) but slightly shorter.

Colour ferruginous-brown.

Measurements in mm and Indices: TL 2.46-2.68; HL 0.56-0.61; HW 0.50-0.55; EL 0.04-0.05; SL 0.33-0.36; WL 0.68-0.72; PeL 0.27-0.30; PeW 0.20-0.21; HFeL 0.35; HTiL 0.33-0.35; HBaL 0.27-0.28; LS4 0.13-0.16; LT4 0.56-0.66; CI 89.3-90.2; SI 58.9-59.0; IGR 0.23-0.24.

*Gyne* (Figs. 8 & 19) (tentative attribution). Differing from the worker in the following details: eyes large and composed by many facets, shorter than  $1/3$  of the head length and with ocular pilosity. Ocelli well developed.

Mesosoma robust and convex in side view. Parapsidal furrows weakly marked. Scutellum with the sides converging posteriorly and with the posterior border rounded. Metanotum without tooth or spine-like projection.

Basal face of the propodeum very short, laterally subround, medially incised and as flat as the declivous face. Propodeal lobes subround. Petiole slightly longer than broad. Gaster slightly more angulate on the curvature.

Fore wings of our type 4, hind wings of our type 3 as defined in the description of the genus.

Measurements in mm and Indices: TL 2.50-2.62; HL 0.53-0.55; HW 0.46-0.48; EL 0.15; SL 0.33-0.34; WL 0.67-0.76; PeL 0.22-0.27; PeW 0.18-0.24; HTiL 0.35-0.40; HBaL 0.28-0.33; LS4 0.16; LT4 0.67-0.69; CI 87.0-87.3; SI 61.8-62.3; IGR 0.23.

*Male* (Figs. 7, 10, 15, 16, 17, 18, 20, 21, 22, 23 & 25) (tentative attribution). Head slightly longer than broad. Vertex in full face view convex. Vertexal margin narrowly carinate. Clypeus medially reduced, subtriangular, separating the and slightly longer than the antennal sockets. Clypeal dorsum with a longitudinal carina extending posteriorly but not reaching the anterior ocellus. Antennal socket with broad torulus. Frontal carinae thin, low, diverging posteriorly and separate from each other. Anterior half of the rostral area gently convex, the posterior half concave. Ocelli extremely large. Compound eyes slightly less than 1/2 or about 1/2 of the head length, placed largely on the anterior head sides and with interommatidial pilosity. Scapes reaching the anterior ocellus backwards. Funicular joints 1-11 longer than broad. Last funicular joint shorter than the sum of joints 9-11. Mandibles elongate, edentate and only with a pointed apical tooth. Palp formula not clearly visible.

Mesosoma robust. Pronotum and anterior third of mesonotum almost perpendicular to the posterior two thirds of the mesonotum. Posterior two thirds of mesonotum gently convex. Parapsidal furrows marked. Scutellum higher than the mesonotum and in full dorsal view with the posterior border round. Propodeum in side view subangulate or convex. Basal face of the propodeum declivous posteriorly, sometimes weakly concave medially and weakly angulate laterally. Declivous face flat. Metanotum with a median spine-like projection. Propodeal lobes small and gently obtuse. Propodeal spiracles relatively large and slightly directed downwards.

Petiole in side view declivous on the anterior third and convex on the two posterior thirds, with parallel sides in the anterior third and convex on the two posterior thirds in dorsal view. Anterior border of the petiole variably concave and superficially carinate. Subpetiolar process in shape of

a narrow, subtriangular lamella. Postpetiole anteriorly slightly broader than the petiole; postpetiolar sides diverging and gently convex posteriorly. Anterior border of the postpetiolar sternite with a projecting triangular "lip". Gastral tergite I round. Gastral sternite I broad in the middle. Remaining gastral tergites and sternites curved ventrally.

Legs elongate. Hind basitarsi about as long as the hind tibiae.

Fore wings of our type 4, hind wings of our type 3 as defined in the description of the genus.

Sculpture. Head variably punctate sparsely granulate, in some specimens the granules more marked close to the vertexal margin and on the ventral part of the head. Mesosoma smooth, with sparse punctation and variably distributed reticulation and granulation, in some specimens the reticulation broader on the pleurae. Propodeum, petiole and postpetiole irregularly reticulate-granulate and with sparse foveae-like irregular depressions; the foveae less impressed and sparse on the dorsum of the postpetiole of some specimens. First gastral tergite smooth and with minute piligerous punctures. Legs with minute piligerous punctures and granules.

Body covered by hairs of three main types: (1) short, subdecumbent or appressed on the whole body, slightly denser on the head; (2) long, suberect and sparse on the whole body; (3) shorter than hair type (1), dense, decumbent on the funicular joints only. In addition the funicular joints bear a few sparse, suberect hairs similar to type (1).

Colour. Dark brown-black.

Measurements in mm and Indices: TL 2.27-2.46; HL 0.44-0.51; HW 0.40-0.46; EL 0.21-0.24; SL 0.29-0.35; WL 0.67-0.77; PeL 0.22-0.28; PeW 0.13-0.20; HFeL 0.45-0.55; HTiL 0.35-0.41; HBaL 0.34-0.40; LS4 0.23-0.32; LT4 0.44-0.57; CI 87.0-93.2; SI 65.9-68.6; IGR 0.52-0.56.

MATERIAL EXAMINED: DOMINICAN AMBER: 2 workers, 1 gyne and 6 males in GOPC (reference numbers: H 10-156 K-1 & 2 (respectively holotype and paratype workers), H 10-156 G (gyne), H 10-156 A, H 10-156 C, H 10-156 I, H 10-156 L, H 10-119, H 10-178 B (males)); 8 males in MCZC (reference numbers: MCZC 26-30, MCZC 32-33, MCZC 35); 1 gyne and 13 males in NHMB (reference numbers: PE 25 (gyne and 12 males), PE 46 (1 male)). MEXICAN AMBER: 1 male in GOPC (reference number: H 10-197-2).

DISCUSSION. *P. poinari* shares with *micrommatum* and with *panamense* the shape of the postpetiole, slightly angulate anterolaterally. *Poinari*, in addition, shares with *mexicanum* the basal face of the propodeum, denticulate and carinate.

Our attribution of the two gynes, H 10-256 G (GOPC) and PE 25 (NHMB) to *poinari* is based on the similarity in sculpture and gastral shape with the workers. We regard this attribution as a reasonable certainty.

The sample PE 25 includes 1 gyne and 12 males. All the remaining 15 males from other amber samples are very similar to those of the sample PE 25 but there are a few differences. In particular the males with reference numbers MCZC-26 & 27, MCZC 32, H 10-119, H 10-156 I and H 10-178 B have the first gastral segment slightly shorter and the petiolar and post-petiolar sculpture more marked.

The single male in Mexican amber is in rather bad shape. It appears to be deformed in a way giving it a slightly more elongate aspect. Otherwise we are unable to detect significant differences between it and the Dominican males.

DISTRIBUTION: Dominican (and Mexican?) amber.

†***Proceratium dominicanum*** de Andrade n. sp.

Figs. 4, 5, 6, 11, 12, 13

TYPE MATERIAL: holotype winged gyne in the Dominican amber sample Do-5188 of the collection of SMNS.

DERIVATIO NOMINIS: "*dominicanum*" is a neologism indicating the provenance from the Dominican Republic.

DIAGNOSIS. A *Proceratium* species belonging to the *micrommatum* clade and resembling *taino* and *mexicanum*, in the gyne, but differing from both by the following measurements and indices: TL < 3.10 mm (instead of > 3.70 mm) and IGR  $\geq$  0.24 (instead of  $\leq$  0.20).

DESCRIPTION. *Gyne* (Figs. 4, 5, 6, & 11). Head longer than broad, narrower anteriorly than posteriorly. Vertex in full face view weakly convex. Clypeus reduced, triangular, slightly longer than the antennal sockets. Antennal socket with broad torulus. Frontal carinae close to each other, not covering the antennal insertions. Frontal area behind the frontal carinae weakly convex. Lateral expansions of the frontal carinae relatively narrow, raised and diverging. Genal carinae marked. A superficial sulcus between the genal carinae and the gular area. Eyes large, slightly shorter than 1/3 of the head length and with ocular pilosity. Ocelli well developed. Scapes thicker in the distal half and not reaching the anterior ocellus posteriorly. First funicular joint 1/3 longer than broad. Funicular joints 2-10 broader than long. Last funicular joint about as long as the sum of joints 6-10. Mandibles with 4 denticles before the apical tooth. Palp formula probably 3,2.

Mesosoma robust and convex in profile. Parapsidal furrows marked. Scutellum with posteriorly converging sides and with the posterior border rounded. Metanotum with a triangular tooth. Basal face of the propodeum short, clearly angulate or denticulate laterally, incised and as flat as the declivous face medially. Propodeal lobes weakly round or obtuse. Propodeal spiracles small.

Petiole longer than broad, with the sides subparallel in the anterior third and convex posteriorly in dorsal view. Anterior border of the petiole concave, carinate and angulate on each side. Ventral process of the petiole small and subtriangular. Postpetiole slightly shorter than 1/2 of the length of the gastral tergite I (LT4), anterolaterally gently angulate and with the sides weakly convex in dorsal view. Postpetiolar sternite anteromedially with a subtriangular projection. Posterior half of the postpetiolar sternite slightly convex. Constriction between postpetiole and gastral segment I deeply impressed. Gastral tergite I convex on the curvature. Gastral sternite I very short medially. Sides of gastral sternite I not protruding anteriorly. Remaining gastral tergites and sternites curved ventrally.

Fore wings of our type 4, hind wings of our type 3 as defined in the description of the genus.

Mid tibiae without spur. Spurs of fore legs without basal spine. Fore basitarsi longer than the mid ones. Hind basitarsi about 1/5 shorter than hind tibiae. Second tarsomere of mid and hind legs longer than the third

and fourth tarsomeres and slightly shorter than pretarsus. Pretarsal claws simple. Arolia very small.

Sculpture. Head, mesosoma, petiole and postpetiole granulopunctate, the punctation more superficial on the pronotum and mesonotum and irregular on the petiole and postpetiole, the granules sparse and small close to the vertexal margin and on the mesosoma, dense and larger on the petiole and postpetiole. Some specimens have the lower metapleurae with additional, thin, irregular longitudinal rugosities. First gastral tergite superficially smooth and minutely punctate; its sides and the ventral part reticulate-punctate and sparsely granulate. Legs punctate.

Body covered by hairs of three main types: (1) short, dense, subdecumbent on the whole body; (2) long, suberect and sparser than in *poinari* on the whole body, longer on the postpetiolar sternite; (3) shorter than hair type (1), dense, decumbent on the funicular joints only. In addition the funicular joints bear whitish, thick, appressed, sparse hairs and suberect hairs similar to type (1) but slightly shorter.

Colour ferruginous-brown or dark brown.

Measurements in mm and Indices: TL 2.80-3.08; HL 0.60-0.67; HW 0.52-0.56; EL 0.17-0.20; SL 0.36-0.42; WL 0.83-0.89; PeL 0.30-0.31; PeW 0.21-0.24; HTiL 0.37-0.42; HBaL 0.27-0.35; LS4 0.17-0.21; LT4 0.67-0.80; CI 84.1-86.6; SI 60.0-63.5; IGR 0.24-0.26.

*Male?* (Fig. 12 & 13) (tentative attribution). Head longer than broad. Vertex in full face view convex. Vertexal margin narrowly carinate. Clypeus medially reduced, triangular, slightly longer than the antennal sockets. Clypeal dorsum with a longitudinal carina extending posteriorly but not reaching the anterior ocellus. Antennal socket with broad torulus. Frontal carinae thin, very low, diverging posteriorly and separate each other. Anterior half of the frons gently convex, the posterior half concave. Ocelli very large. Compound eyes slightly shorter than half of the head length, placed largely on the anterior part of the head sides and with ocular pilosity. Scapes slightly surpassing the vertex. Funicular joints 1-11 about half longer than broad. Last funicular joint longer than the sum of joints 10-11. Mandibles elongate, edentate and only with a pointed apical tooth. Palp formula not visible.

Mesosoma robust. Pronotum and anterior third of mesonotum almost perpendicular to the posterior two thirds of the mesonotum. Posterior two



thirds of mesonotum gently convex. Parapsidal furrows marked. Scutellum higher than the mesonotum and with the posterior border round in full dorsal view. Propodeum in side view weakly convex. Basal face of the propodeum declivous posteriorly and weakly concave medially. Declivous face flat. Metanotum with median spine-like projection. Propodeal lobes small and obtuse. Propodeal spiracles slightly directed downwards.

Petiole in profile declivous on the anterior third and convex on the two posterior thirds, with parallel sides in the anterior third and convex on the two posterior thirds in dorsal view. Anterior border of the petiole concave and carinate. Subpetiolar process forming a narrow, subtriangular lamella. Postpetiole anteriorly slightly broader than the petiole; postpetiolar sides diverging and gently convex posteriorly. Anterior border of the postpetiolar sternite with a projecting triangular "lip".

Gastral tergite I round. Gastral sternite I broad in the middle. Remaining gastral tergites and sternites curved ventrally.

Legs elongate. Spurs of fore legs without basal spine. Mid tibiae without spur. Hind basitarsi about as long as the hind tibiae.

Fore wings of our type 4, hind wings of our type 3 as defined in the description of the genus.

Sculpture. Head reticulate-punctate, vertexal margin with sparse granulation. Mesosoma, petiole and postpetiole reticulate-punctate granulate; this sculpture very superficial on the dorsum of the mesonotum; the reticulation larger and mixed with irregular foveae-like depressions on the scutellum, propodeum, petiole and postpetiole. First gastral tergite smooth and with minute piligerous punctures. First gastral sternite punctate and irregularly reticulorugose. Legs with minute piligerous punctures and granules.

Body covered by hairs of three main types: (1) short, subdecumbent or decumbent on the whole body; (2) long, suberect and sparse on the whole body; (3) shorter than hair type (1), dense, decumbent on the funicular joints only. In addition the funicular joints bear sparse, suberect hairs similar to type (1).

Colour. Black.

Measurements in mm and Indices: TL 3.05; HL 0.57; HW 0.50; EL 0.25; SL 0.46; WL 0.96; PeL 0.28; PeW 0.18; HFeL 0.75; HTiL 0.52; HBaL 0.51; LS4 0.40; LT4 0.76; CI 87.7; SI 80.7; IGR 0.53.

MATERIAL EXAMINED: DOMINICAN AMBER: 2 gynes in SMNS (reference numbers: Do-5188 (holotype), Do-4253; 3 gynes and 1 male in GOPC (reference numbers: H 10-156 B, H 10-156 F, H 10-221, H 10-222 (male)); 2 gynes in MCZC (reference numbers: MCZC-31, MCZC-34).

DISCUSSION. *Dominicanum* resembles *taino* and *mexicanum* in general body shape. *Dominicanum* shares only with *mexicanum* the basal face of the propodeum laterally angulate or denticulate and only with *taino* the mid basitarsi without a hair long 1/2 or more than the mid basitarsus. *Dominicanum* has the second gastral sternite less protruding anteriorly than *mexicanum* and less flattened than *taino*.

The attribution of the single male H 10-222 to the same species as the gynes is purely speculative.

This tentative attribution is based essentially on the fact that this male, by the absence of a mid tibial spur, belongs unequivocally to the *micrommatum* clade. There are only two known species of Dominican amber *Proceratium* in the *micrommatum* clade: *poinari* and *dominicanum* and the male of *poinari* is already known with reasonable confidence.

DISTRIBUTION: Dominican amber.

### ***Proceratium taino* de Andrade n. sp.**

Fig. 80

*Proceratium micrommatum* (Roger), Ward, 1988: 117 (identification key; material from Antilles). Nec Roger, 1863. Partim. Misidentification.

TYPE MATERIAL: holotype worker from the Dominican Republic labelled: "La Vega Prov. PN. A. Bermudez, 4 km SW Cienaga. 1200 m, 21.VII.1995. S. + J. Peck, for. litter, 95-42", in MCZC.

DERIVATIO NOMINIS: from "Taino", the name of the inhabitants of the island of Hispaniola at the time of the European arrival in the Caribbean.

DIAGNOSIS. A *Proceratium* species belonging to the *micrommatum* clade and resembling *mexicanum* and *dominicanum*, but differing from *mexicanum*, in the worker and gyne, by the following characters: gastral sternite

I laterally flat instead of protruding anteriorly and by the mid basitarsi without a hair long  $1/2$  of the mid basitarsal length or longer; and from *dominicanum*, in the gyne, by the TL = 4.00 mm instead of < 3.10 mm and by the IGR = 0.20 instead of  $\geq 0.24$ .

DESCRIPTION. *Worker* (Fig. 80). Head slightly longer than broad, narrower anteriorly than posteriorly. Vertex in full face view weakly convex and medially superficially incised. Clypeus reduced, triangular, slightly longer than the antennal sockets. Antennal socket with broad torulus. Frontal carinae close each other, not covering the antennal insertions. Frontal area behind the frontal carinae weakly protruding. Lateral expansions of the frontal carinae relatively narrow, raised, subparallel or gently diverging posteriorly. Genal carinae poorly marked. A superficial sulcus between the genal carinae and the gular area. Eyes composed by a clearly convex facet and placed below the mid-line of the head. Scapes thicker in the distal half and short of the vertexal margin. First funicular joint slightly shorter than  $1/2$  of their width. Funicular joints 2-10 broader than long. Last funicular joint about as long as the sum of joints 6-10. Mandibles with 4 denticles before the apical tooth. Palp formula probably 3,2.

Mesosoma slightly convex in profile. Promesonotal and propodeal sutures superficially impressed. Promesopleural and mesometapleural sutures impressed on the ventral half only. Basal face of the propodeum gently convex anteriorly, declivous posteriorly and with a superficial, transversal sulcus close to the declivous face; postero-lateral border of the sulcus subangulate. Declivous face of the propodeum with crenulate sides. Propodeal lobes ventrally truncate and dorsally obtuse and with crenulate margin. Propodeal spiracles tumuliform and oriented downwards. Metapleurae below the propodeal spiracles concave.

Petiole about as long as broad, with the sides subparallel in the anterior third and convex posteriorly in dorsal view. Anterior border of the petiole concave and angulate on each side. Ventral process of the petiole triangular. Postpetiole slightly less than  $1/2$  of the length of the gastral tergite I (LT4), in dorsal view with convex sides. Postpetiolar sternite anteromedially with a subtriangular projection. Posterior half of the postpetiolar sternite slightly convex or straight. Constriction between postpetiole and gastral segment I impressed. Gastral tergite I relatively long, sub-oval. Gastral sternite I very

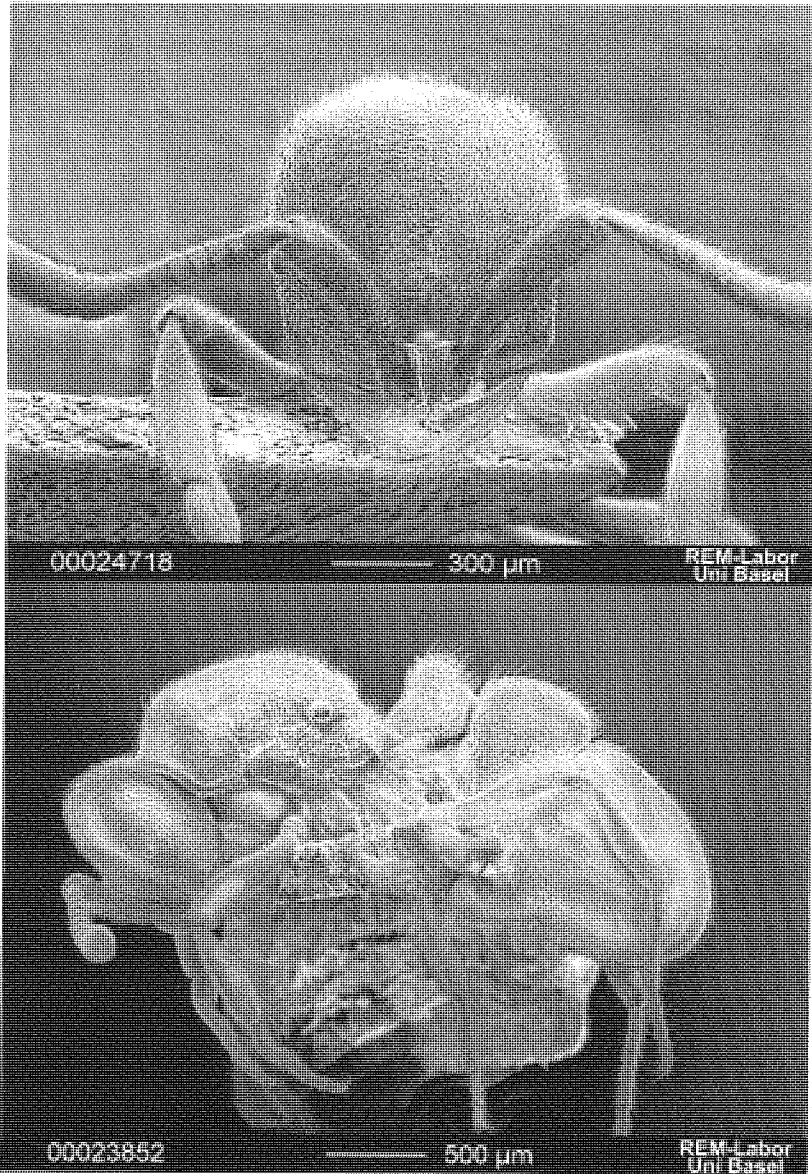


Fig. 80 – *Proceratium taino* de Andrade. Worker (holotype) from La Vega Province, National Park A. Bermudez, Dominican Republic: head (top) in dorsal view and meso- and metasoma (bottom) in side view.

short medially. Sides of gastral sternite I neither carinate nor protruding anteriorly. Remaining gastral tergites and sternites curved ventrally.

Mid tibiae without spur. Spurs of fore legs without basal spine. Fore basitarsi longer than the mid ones. Hind basitarsi about 1/6 shorter than hind tibiae. Second tarsomere of mid and hind legs longer than third and fourth tarsomeres, and slightly shorter than pretarsus. Fourth tarsomere of fore legs much longer than each tarsomere 1-3, and shorter than the sum of tarsomeres 1-2. Pretarsal claws simple. Arolia very small.

Sculpture. Head punctate, sparsely granulate. Mesosoma, petiole and postpetiole granulate-punctate and with thin, irregular rugae, the granules superficial on the center of the pronotum and mesonotum, marked on the petiole and postpetiole. First gastral tergite smooth and minutely punctate; its sides and ventral part granulate-punctate. Legs punctate.

Body covered by hairs of three main types: (1) short, dense, subdecumbent on the whole body, in some parts of the mesosoma erect; (2) long, suberect on the whole body, slightly longer on the anterior part of the pronotum and on the postpetiolar sternite, absent on the funiculi; (3) shorter than hair type (1), dense, decumbent on the funicular joints only. In addition the funicular joints bear whitish, thick, appressed, sparse hairs and suberect hairs similar to type (1) but slightly shorter.

Colour dark ferruginous-brown.

Measurements in mm and Indices: TL 3.70-4.30; HL 0.85-0.94; HW 0.76-0.86; EL 0.06; SL 0.56-0.64; WL 1.00-1.16; PeL 0.37-0.40; PeW 0.35-0.40; HFeL 0.68-0.85; HTiL 0.57-0.68; HBaL 0.46-0.56; LS4 0.18-0.22; LT4 0.91-1.14; CI 89.4-91.5; SI 65.9-68.1; IGR 0.19-0.20.

*Gyne* (tentative attribution). Differing from the worker in the following details: eyes large and composed by many facets, long about 1/4 of the head length and with ocular pilosity. Ocelli well developed.

Mesosoma robust and convex in profile. Parapsidal furrows weakly marked. Scutellum with the sides converging posteriorly and with the posterior border rounded. Metanotum without tooth or spine-like projection. Basal face of the propodeum very short, laterally sub-angulate, medially gently incised and almost as flat as the declivous face. Petiole slightly longer than broad.

Sculpture: center of pronotum and mesonotum smooth and with minute piligerous punctures.

Measurements in mm and Indices: TL 4.01; HL 0.87; HW 0.79; EL 0.20; SL 0.58; WL 1.12; PeL 0.37; PeW 0.35; HFeL 0.51; HTiL 0.63; HBaL 0.51; LS4 0.22; LT4 1.06; CI 90.8; SI 66.7; IGR 0.21.

MATERIAL EXAMINED: Dominican Republic : La Vega Province, National Park Armando Bermúdez, 4 km SW Ciénaga, 1200 m, 21.VII.1995, forest litter, 95-42, 1 worker (holotype), S. & J. Peck [MCZC]; same locality, date and collectors, 1 gyne, tropical evergreen forest litter, 95-44 [MCZC]; La Vega Province, La Ciénaga, 1100 m, mixed hw-pine valley forest, 19.VII.1986, 1 worker, W. L. Brown [MCZC].

DISCUSSION. The worker from La Ciénaga (19.VII.1986) differs from the worker from the National Park Armando Bermúdez by the shape of the propodeum which is less angulate laterally.

DISTRIBUTION: Dominican Republic.

### ***Proceratium longiscapus* de Andrade n. sp.**

Figs. 81, 82

TYPE MATERIAL: holotype gyne from the Dominican Republic labelled: "Dominican Republic, Bonao, 29.VIII.1997, C. O'Brien & R. Baronowski, blacklight trap", in MCZC.

DERIVATIO NOMINIS: from the Latin *longus* (= long) and *scapus* (= stalk), referred to the most salient morphological trait of this species.

DIAGNOSIS. A *Proceratium* species belonging to the *micrommatum* clade and differing from all the other species of the clade, in the gyne, by the antennal scapes reaching the cephalic vertex posteriorly and by the antennal joints longer than broad.

DESCRIPTION. *Gyne* (Figs. 81 & 82). Head longer than broad and with subparallel sides. Vertex in full face view weakly convex. Clypeus reduced, subround and slightly longer than the antennal sockets. Antennal socket

with broad torulus. Frontal carinae close each other, not covering the antennal insertions. Frontal area behind the frontal carinae weakly convex. Lateral expansions of the frontal carinae relatively narrow, feebly raised and parallel. Genal carinae marked. A sulcus between the genal carinae and the gular area. Eyes large, about 1/4 of the head length and with ocular pilosity. Ocelli well developed. Scapes reaching the vertexal margin. First funicular joint about 1/2 longer than broad. Funicular joints 2-10 longer than broad. Last funicular joint about as long as the sum of joints 6-10. Mandibles with 4 denticles before the apical tooth. Palp formula probably 3,2.

Mesosoma convex in side view. Parapsidal furrows marked. Scutellum with the sides converging posteriorly and with the posterior border rounded. Metanotum without triangular tooth. Basal face of the propodeum short, weakly angulate laterally, incised and almost as flat as the declivous face medially. Propodeal lobes round. Propodeal spiracles small.

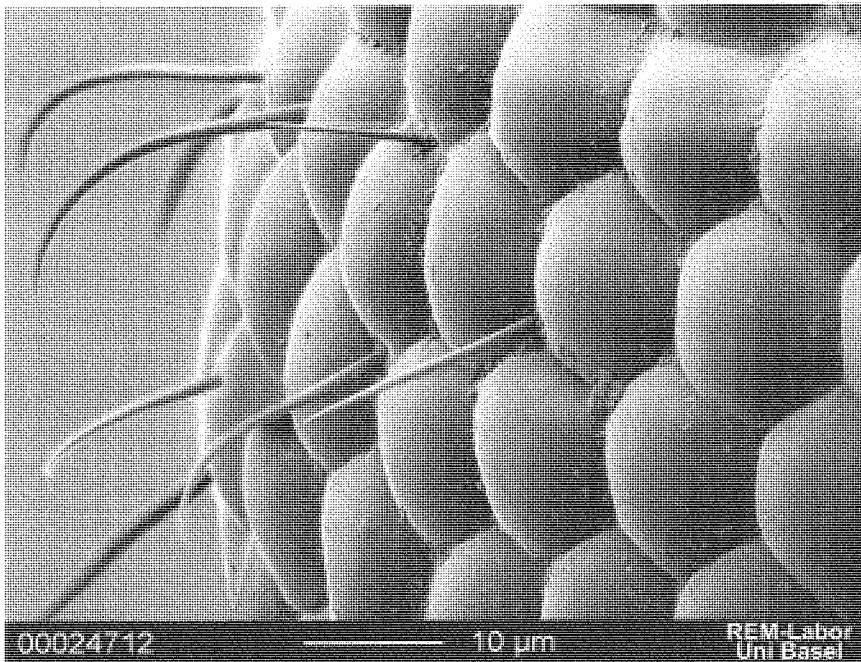


Fig. 81 – *Proceratium longiscapus* de Andrade. Gyne (holotype) from Bonao, Dominican Republic: ocular pilosity.

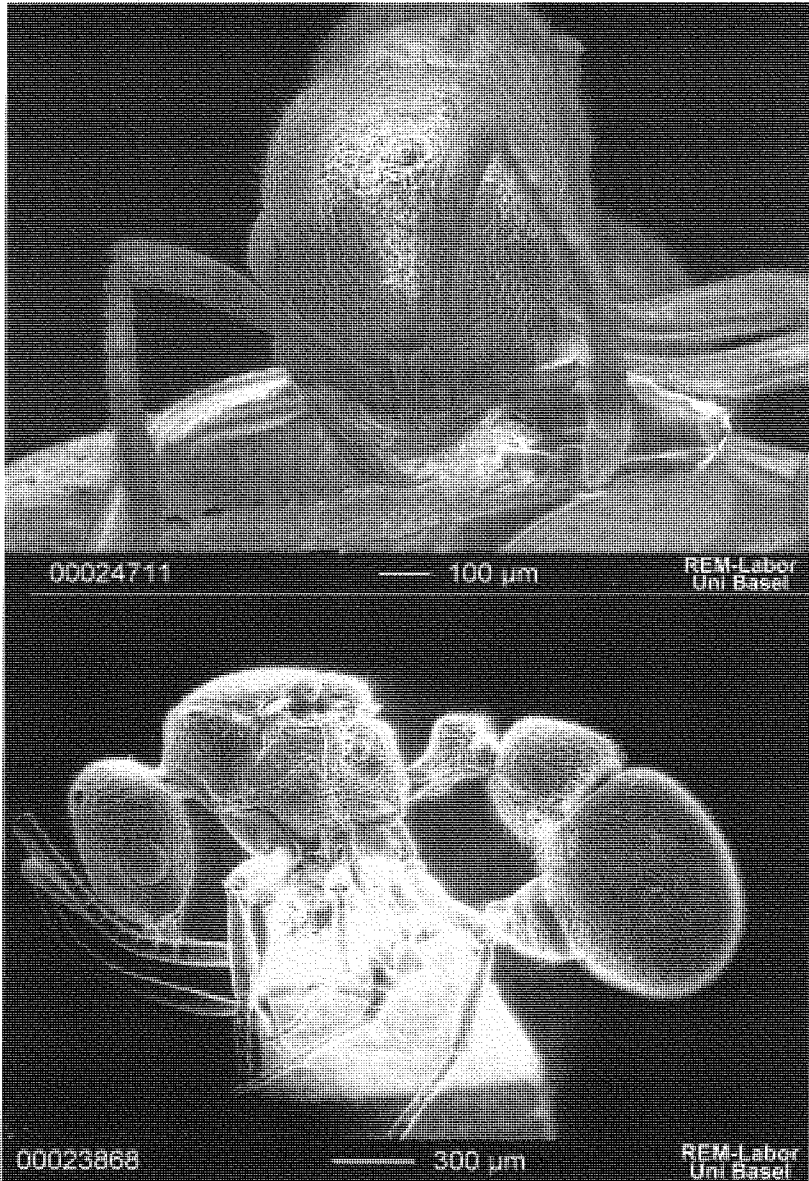


Fig. 82 – *Proceratium longiscapus* de Andrade. Gyne (holotype) from Bonao, Dominican Republic: head (top) in dorsal view and meso- and metasoma (bottom) in side view.



Petiole longer than broad, with the sides subparallel in the anterior third and convex posteriorly in dorsal view. Anterior border of the petiole almost straight and carinate. Ventral process of the petiole corresponding to a narrow, crenulate, longitudinal lamella. Postpetiole slightly shorter than 1/2 of the gastral tergite I (LT4), with the sides gently convex in dorsal view. Postpetiolar sternite anteromedially with a subtriangular projection. Posterior half of the postpetiolar sternite flat. Constriction between postpetiole and gastral segment I impressed. Gastral tergite I convex on the curvature. Gastral sternite I short medially. Sides of gastral sternite I flat and not protruding anteriorly. Remaining gastral tergites and sternites curved ventrally.

Mid tibiae without spur. Spurs of fore legs without basal spine. Fore basitarsi longer than the mid ones. Hind basitarsi about 1/6 shorter than hind tibiae. Second tarsomere of mid and hind legs longer than the third and fourth and slightly shorter than pretarsus. Pretarsal claws simple. Arolia very small.

Fore wings of our type 4, hind wings of our type 3 as defined in the description of the genus.

Sculpture. Head with small reticulation, sparsely rugulose and granulate. Pronotum, scutellum, pleurae and basal face of the propodeum with small granulation and rare, short, thin, rugosities, the rugosities tickier on the metapleurae. Mesonotum with superficial, small piligerous punctures. Petiole and postpetiole granulate. First gastral tergite superficially smooth and covered by small piligerous punctures, larger on the sides. Legs punctate.

Body covered by hairs of three main types: (1) short, dense, subdecumbent on the whole body; (2) longer than hair type (1), erect and sparse on the whole body, shorter on the scapes; (3) shorter than hair type (1), dense, decumbent on the funicular joints only. In addition the funicular joints bear whitish, sparse, tick, appressed hairs and suberect hairs similar to type (1) but slightly shorter.

Colour light brown.

Measurements in mm and Indices: TL 3.15; HL 0.71; HW 0.58; EL 0.18; SL 0.60; WL 0.90; PeL 0.31; PeW 0.26; HTiL 0.48; HBaL 0.40; LS4 0.19; LT4 0.80; CI 81.6; SI 84.5; IGR 0.24.

MATERIAL EXAMINED: DOMINICAN REPUBLIC: Bonao, 29.VIII.1997, blacklight trap, 1 gyne (holotype), C. O'Brien & R. Baronowski [MCZC].

DISCUSSION. *Longiscapus*, known from the gyne only, is a very distinct species. Its long scape easily differentiates it from all the other gynes of the *micrommatum* clade, as already stated in the diagnosis. This species, in addition, has the second gastral sternite flat as *taino*. The hairs of type (2) are short and sparse as those of the worker of *cubanum*.

DISTRIBUTION: Dominican Republic.

***Proceratium cubanum*** de Andrade n. sp.

Fig. 83

*Proceratium micrommatum* (Roger), Borgmeier, 1957: 118. Nec Roger, 1863. Partim. Worker from Cuba, nec gyne (= *micrommatum*). Misidentification.

*Proceratium micrommatum* (Roger), Brown, 1958a: 248 & 333. Nec Roger, 1863. Partim. Material from Cuba only. Misidentification.

*Proceratium micrommatum* (Roger), Brown, 1980: 342. Nec Roger, 1863. Partim. Misidentification.

TYPE MATERIAL: holotype worker from Cuba labelled: "Holguín, Ote, II-1976, L. Armas, bajo piedra", in LACM.

DERIVATIO NOMINIS: "*cubanum*" is a neologism indicating the provenance of this species from Cuba.

DIAGNOSIS. A *Proceratium* species belonging to the *micrommatum* clade and resembling *poinari* and *taino*, in the worker, but differing from *poinari* by the lack of a clear propodeal carina, by the postpetiole anterolaterally round instead of angulate and by the mid basitarsi without hairs longer than 1/2 of the hind basitarsi; and from *taino*, in the worker, by the smaller size (TL  $\leq$  3.00 mm instead of  $\geq$  3.70 mm) and by the hairs of type 2 sparser.

DESCRIPTION. *Worker* (Fig. 83). Head longer than broad, slightly narrower anteriorly than posteriorly. Vertex in full face view weakly convex. Clypeus very reduced, triangular and slightly longer than the antennal sockets. Antennal socket with broad torulus. Frontal carinae close to each other, not covering the antennal insertions. Frontal area behind the frontal carinae

weakly convex. Lateral expansions of the frontal carinae relatively narrow, raised and parallel. Genal carinae marked. A superficial sulcus between the genal carinae and the gular area. Eyes composed by a clearly convex facet and placed below the midline of the head. Scapes thicker in the distal half and short of the vertexal margin. First funicular joint  $1/3$  longer than broad. Funicular joints 2-10 broader than long. Last funicular joint as long as the sum of joints 6-10. Mandibles with 3 denticles before the apical tooth. Palp formula probably 3,2.

Mesosoma weakly convex in profile. Promesonotal and propodeal sutures absent. Promesopleural and mesometapleural sutures impressed on the ventral half only. Basal face of the propodeum gently declivous and with a superficial, transversal sulcus close to the declivous face; the sulcus poorly impressed and weakly marginate posteriorly. Declivous face of the propodeum with the sides superficially marginate, the margin more marked posteriorly. Propodeal lobes subround and with variably crenulate margin. Propodeal spiracles small and projecting.

Petiole about as long as broad, with the sides subparallel in the anterior fourth and convex posteriorly in dorsal view. Anterior border of the petiole slightly concave, carinate and angulate on each side. Ventral process of the petiole subtriangular and small. Postpetiole slightly shorter than  $1/2$  of the length of the gastral tergite I (LT4), anterolaterally convex in dorsal view. Postpetiolar sternite anteromedially with a superficially raised subtriangular projection. Posterior half of the postpetiolar sternite straight or slightly convex. Constriction between postpetiole and gastral segment I deeply impressed. Gastral tergite I convex on the curvature. Gastral sternite I very short medially. Sides of gastral sternite I not protruding, superficially carinate only. Remaining gastral tergites and sternites curved ventrally.

Mid tibiae without spur. Spurs of fore legs without basal spine. Fore basitarsi longer than the mid ones. Hind basitarsi about  $1/5$  shorter than hind tibiae. Second tarsomere of mid and hind legs longer than third and fourth tarsomeres, and slightly shorter than pretarsus. Pretarsal claws simple. Arolia very small.

Sculpture. Head, mesosoma, petiole and postpetiole granulopunctate, the granules more marked on the petiole and postpetiole. In addition, the head with thin, irregular rugosities. First gastral tergite smooth and with minute piligerous foveae; sides and posterior part of the first gastral tergite

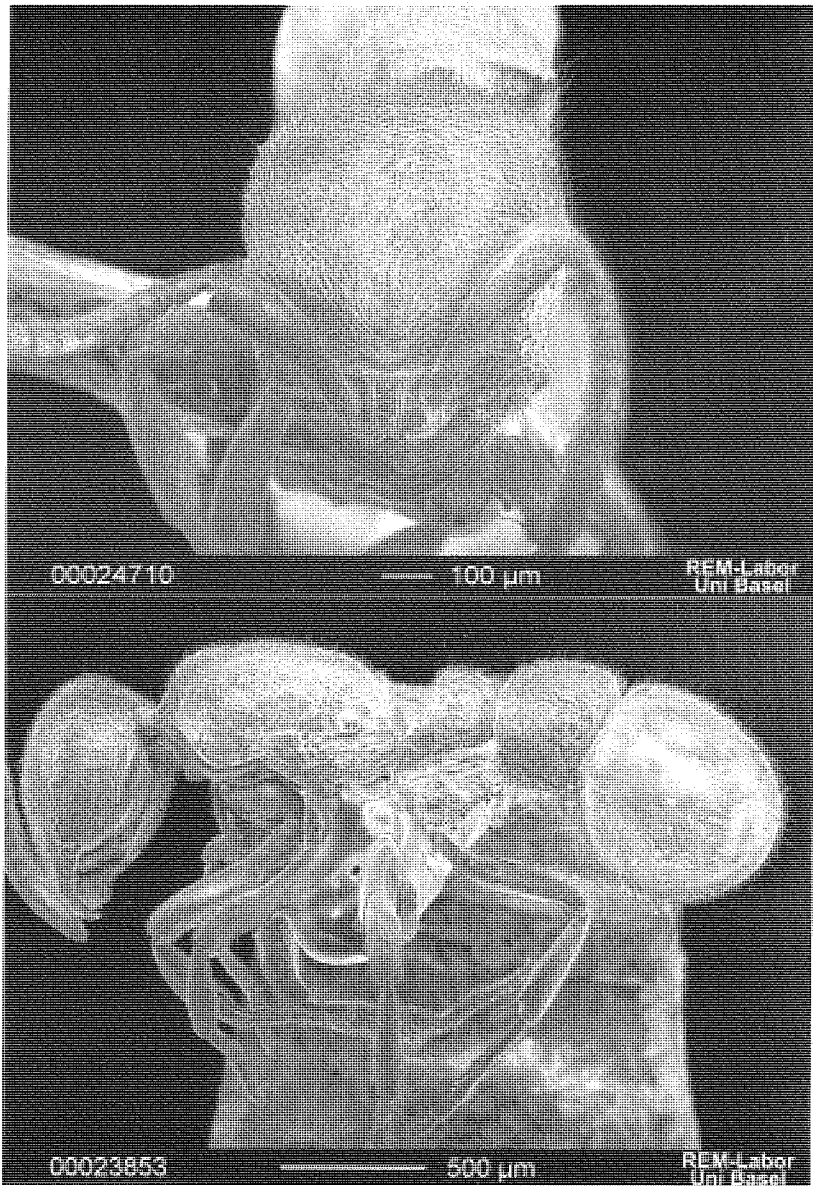


Fig. 83 – *Proceratium cubanum* de Andrade. Worker (holotype) from Holguín, Cuba: head (top) in dorsal view and meso- and metasoma (bottom) in side view.

with larger piligerous punctures which are substituted by reticulation and granules close to the border. Legs variably granulate-punctate.

Body covered by hairs of three main types: (1) short, dense, subdecumbent on the whole body; (2) long, erect and sparse on the whole body except the funiculi; (3) shorter than hair type (1), dense, decumbent on the funicular joints only. In addition the funicular joints bear whitish, thick, appressed, sparse hairs and suberect hairs similar to type (1) but slightly shorter.

Colour light brown.

Tab. II - Synopsis of the characters distinguishing four closely related species previously confused under *micrommatum*.

	<i>micrommatum</i>	<i>convexiceps</i>	<i>cubanum</i>	<i>mexicanum</i>
Genal carinae	superficial	impressed	impressed	impressed
Mesosoma	nearly straight in profile	convex in profile	nearly straight in profile	weakly convex in profile
Transversal propodeal carina	superficial	superficial	superficial	impressed
Postpetiole	anteriorly angulate	anteriorly convex	anteriorly convex	anteriorly convex
Gaster	elongate and weakly angulate	shorter and strongly convex	shorter and strongly convex	shorter and strongly convex
IGR	0.14-0.16	0.16-0.18	0.21-0.23	0.19-0.21
Sculpture	superficial	deeper	superficial	superficial
Foveae	present	present	absent	present
Colour	light ferrugineous to brown	dark ferrugineous	light brown	light ferrugineous to brown
MBa long hair	present	present	absent	present
Erect pilosity	dense	dense	sparse	dense

Measurements in mm and Indices: TL 2.96-3.00; HL 0.70; HW 0.62; EL 0.04-0.09; SL 0.44-0.45; WL 0.80-0.81; PeL 0.28; PeW 0.26-0.29; HTiL 0.43; HBaL 0.35-0.37; LS4 0.16; LT4 0.70-0.75; CI 88.6; SI 62.8-64.3; IGR 0.21-0.23.

MATERIAL EXAMINED: CUBA: ORIENTE: Holguín, II.1976, 1 worker, holotype, [LACM]. CIENFUEGOS: Soledad, 2.VI.1950, 1 worker, H. B. Mills [MZSP].

DISCUSSION. Borgmeier (1957) considered his *Sysphincta cavernicola* as a synonym of *Proceratium micrommatum* (Roger). In the same paper Borgmeier (l. c.) re-described *micrommatum* on a single worker from Cuba (Soledad) and a new species from Costa Rica as *convexiceps*. Brown (1980) proposed the synonymy of *convexiceps* with *micrommatum*. We already gave the reasons of our disagreement with this interpretation in the discussion of *convexiceps* (q. v.). Of the two Cuban workers known to date, the worker from Holguín differs from the one from Soledad mainly by the absence of dark spots on the vertex and by the smaller eyes composed by a single facet without ocular pilosity. Both *convexiceps* and *micrommatum* are valid species and both specimens from Cuba belong to the new species described above as *cubanum*. It is true that the members of the *micrommatum* clade are very similar to each other but *cubanum* can be differentiated from *micrommatum* and from *convexiceps* by characters given in Tab. II.

DISTRIBUTION: Cuba

## THE *MICROSCULPTUM* CLADE

This clade comprises only one species, *P. microsculptum* from Sabah. *Microsculptum* shares with the members of the *stictum* clade and with the basalmost species of the *micrommatum* clade, *transitionis*, the anterior clypeal border broad and protruding anteriorly.

*Microsculptum* shares with *terroni* and *toschii* (the sole two species of the *toschii* clade) the frontal carinae very close to each other and fused posteriorly. It shares with three members of the *pergandei* clade (*compitale*, *creek* and *confinium*) the first funicular joint 1/2 longer than broad. With the six species of the *pergandei* clade and with two species of the *itoi* clade it shares the propodeum with lateral lamellae. *Microsculptum*, in addition, shares with the members of the *itoi* clade the gastral sternite II protruding over the postpetiolar sternite.

*Microsculptum*, in addition, results characterised by 4 autapomorphies: frontal carinae close each other and posteriorly attached; first funicular joint 1/2 longer than broad; presence of propodeal lamellae and second gastral sternite protruding medially. All these peculiarities largely justify inclusion of this species in a clade of its own.

### ***Proceratium microsculptum* de Andrade n. sp.**

Fig. 84

TYPE MATERIAL: holotype worker from Sabah labelled: "SABAH, Gn. Silam, 810 m, 1983, R. Leakey"; in BMNH; paratypes: 2 workers and 1 gyne, same data and collection as the holotype.

DERIVATIO NOMINIS: "*microsculptum*" is a barbarism alluding to the fine integumental structure of this species.

DIAGNOSIS. A *Proceratium* species exhibiting the apomorphies already listed above and differing from all the other species of the genus, in the worker and gyne, by the following combination of characters: frontal carinae posteriorly contiguous, genal carinae strongly marked, second gastral

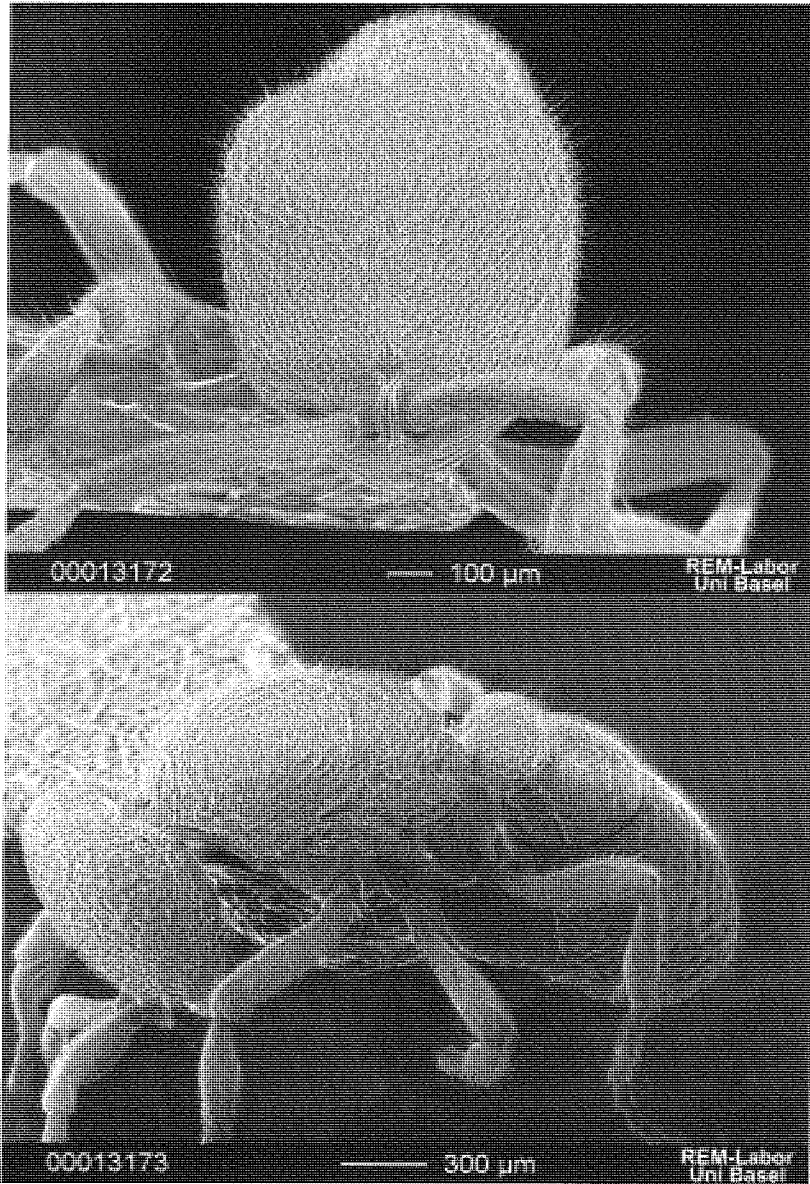


Fig. 84 – *Proceratium microsulptum* de Andrade. Worker (paratype) from Gunung Silam, Sabah: head (top) in dorsal view and meso- and metasoma (bottom) in side view.



tergite entirely foveolate, propodeal suture dorsally impressed and declivous face of the propodeum with lamellae.

DESCRIPTION. *Worker* (Fig. 84). Head slightly longer than broad, its sides gently diverging posteriorly. Vertex in full face view almost straight. Clypeus anteriorly protruding, lamellaceous, relatively broad, subconvex and completely surrounding the antennal sockets. Anterior border of the clypeus subtruncate and crenulate. Frontal carinae fused posteriorly, not covering the antennal insertions. Lateral expansions of the frontal carinae narrow and raised. Genal carinae strongly marked, lamellaceous; each carina corresponding to the external border of a deep sulcus. Eyes absent. First funicular joint  $1/2$  longer than broad. Funicular joints 2-10 slightly broader than long. Last funicular joint about as long as the sum of joints 7-10. Scapes short of the vertexal margin and gently thickening apically. Masticatory margin of the mandibles with 2-3 denticles before the pointed apical tooth. Palp formula 4,3.

Mesosoma gently convex and slightly longer than the maximum head length (mandibles included) in profile. Propodeal suture superficially impressed. Basal face of the propodeum declivous posteriorly. Declivous face of the propodeum flat. Basal and declivous faces of the propodeum separated dorsally by a well marked, diverging carina, the carina connected to a subround, broad tooth on each side. Each side of the declivous face of the propodeum with a broad lamella, broader and round posteriorly. Propodeal spiracle round and over the mid height in lateral view.

Petiole strongly convex in profile, with the sides parallel on the anterior sixth and strongly convex posteriorly in dorsal view. Anterior border of the petiole concave and laterally carinate, the carina denticulate each side. Ventral process of the petiole triangular and pointed. Postpetiole anteriorly slightly broader than the petiole; its sides diverging and gently convex posteriorly. Postpetiolar sternite anteromedially with a marked subtriangular projection, almost straight in side view. Constriction between postpetiole and gaster impressed. Gastral tergite I slightly shorter than twice than the postpetiole, weakly angulate on the curvature. Remaining gastral tergites and sternites curved ventrally.

Legs slender and slightly elongate. All tibiae with a pectinate spur. Spurs of fore legs without basal spine. Fore basitarsi longer than the mid

ones. Hind basitarsi about 1/5 shorter than hind tibiae. Second tarsomere of hind legs subequal in size to the pretarsus. Pretarsal claws simple. Arolia present.

Sculpture. Head, mesosoma and petiole granulopunctate, irregularly rugulose-foveolate; the foveae very sparse on the head. Postpetiole punctate-foveolate. Gaster smooth, minutely punctate and covered by large foveae. Legs punctate.

Body covered by hairs of three main types: (1) short, dense, subdecumbent on the whole body, sparse and suberect on the funicular joints; (2) longer than type (1), erect on the whole body, slightly shorter on the scapes; (3) shorter than hair type (1), dense and decumbent on the funicular joints only. In addition the funicular joints bear whitish, thick, appressed, sparse hairs.

Colour. Ferruginous brown.

Measurements in mm and Indices: TL 3.60; HL 0.84-0.85; HW 0.76-0.78; EL absent; SL 0.61; WL 1.03-1.04; PeL 0.33; PeW 0.32-0.33; HFeL 0.68; HTiL 0.55-0.56; HBaL 0.43; LS4 0.19-0.20; LT4 0.90-0.91; CI 90.5-91.8; SI 71.8-72.6; IGR 0.21-0.22.

*Gyne*. Differing from the worker in the following details: eyes large, their maximum diameter 1/5 of the head length and composed of many facets with interommatidial pilosity. Ocelli well developed.

Mesosoma robust and convex in profile. Parapsidal furrows weakly marked. Scutellum with the sides converging posteriorly and with the posterior border subtruncate. Metanotum with a lamellaceous tooth.

Measurements in mm and Indices: TL 4.11; HL 0.87; HW 0.81; EL 0.17; SL 0.65; WL 1.24; PeL 0.37; PeW 0.36; HFeL 0.77; HTiL 0.60; HBaL 0.48; LS4 0.20; LT4 1.06; CI 93.1; SI 74.7; IGR 0.19.

MATERIAL EXAMINED: MALAYSIA: SABAH: Gunung Silam, 810 m, 8.II.1983, 3 workers (holotype and paratypes), 1 gyne (paratype), R. Leakey [BMNH].

DISCUSSION. *P. microsulptum*, in our phylogeny of the genus, appears as the outgroup of the *stictum* and *micrommatum* clades.

DISTRIBUTION: Malaysia (Sabah).

## THE *PERGANDEI* CLADE

This clade includes 11 species: *algericum*, *californicum*, *chickasaw*, *compitale*, *creek*, *melitense*, *melinum*, *morisitai*, *confinium*, *pergandei* and *watasei*. Five species (*californicum*, *chickasaw*, *creek*, *compitale* and *pergandei*) are confined to the southern Nearctic Region and six to the southern Palearctic.

The members of this clade share the following synapomorphy: worker, gyne and male, spur of fore tibiae with a basal spine. This character is synapomorphic for the 11 species of the *pergandei* clade in spite of its homoplastic occurrence in the species of the *stictum* clade. There are another two characteristic traits shared by the species of the *pergandei* clade: worker and gyne head without genal carinae, and funicular joints 2-10 about as broad as long. The synapomorphic status of both these characters, however, results as equivocal from our cladistic analysis.

### ***Proceratium compitale* Ward**

Fig. 85

*Proceratium compitale* Ward, 1988: 113, fig. 6 (worker). Worker and gyne. Original description. Type locality: Texas, USA and Coahuila, Mexico. Type material: Holotype worker from Val Verde Co., Texas in LACM (not seen); one worker (paratype) labelled "Tex., Val Verde Co.: Emerald Sink, 3 Nov. 84, J. Reddell et M. Reyes, colls, *Proceratium compitale* Ward, Paratype worker, Det. P. S. Ward, 1987"; one gyne (paratype) labelled: "Blackstone Cave, Terrell Co. Texas, 5 Feb. 1967, D. McKenzie + D. Erickson, *Proceratium compitale* Ward, Paratype gyne, Det. P. S. Ward, 1987", both in MCZC; one gyne (paratype) labelled: "15 mi NW Cd. Acuña, Cueva de los Lagos, Coah., Mex. I-24-66, J. H. Reddell, coll., collection of Nat. History Museum of Los Angeles County, Los Angeles, Calif., *Proceratium compitale* Ward, paratype gyne, Det. P. S. Ward, 1987", in LACM, all examined except the holotype.

DIAGNOSIS. A *Proceratium* species belonging to the *pergandei* clade and differing from its sister species, *creek* by its smaller size (worker TL < 5.0

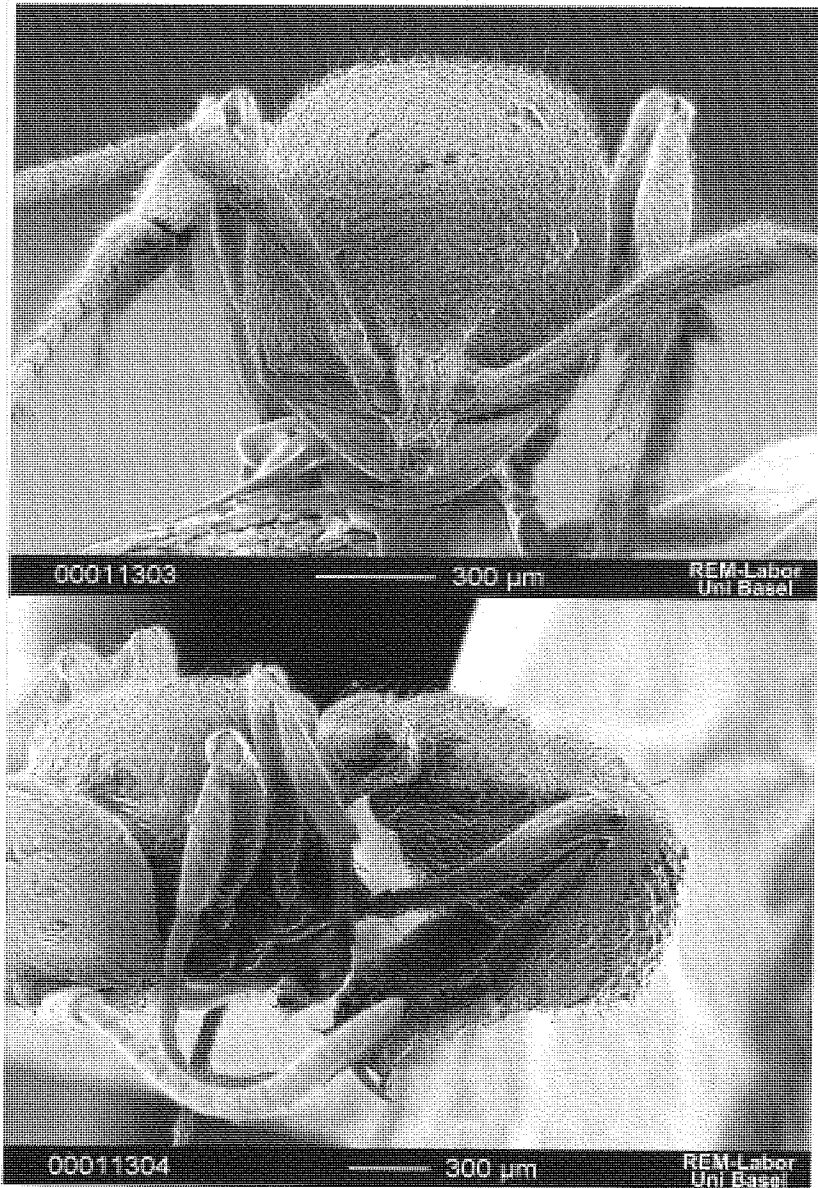


Fig. 85 – *Proceratium compitale* Ward. Worker (paratype) from Val Verde Co, Texas, USA: head (top) in dorsal view and meso- and metasoma (bottom) in side view.

mm instead of  $\geq 5.5$  mm, gyne TL  $\leq 5.78$  mm instead of TL 6.68 mm, worker SL 0.81 mm instead of SL  $\geq 0.96$  mm; gyne SL  $\leq 0.89$  mm, instead of SL 1.06 mm). These measures may have allometric behaviour in the two species (e. g. workers *compitale* CI  $\geq 84.0$ , and, *creek* CI  $\leq 82.0$ ; and gynes, *compitale* CI  $\geq 89.1$ , *creek* CI 80.0).

DESCRIPTION. *Worker* (Fig. 85). Head longer than broad, its sides subparallel anteriorly, weakly convex in the middle and strongly converging posteriorly. Vertexal margin convex. Anteromedian part of the clypeus rectangular and strongly protruding anteriorly, dorsally with a marked inverted Y-shaped carina. Frontal carinae subparallel, slightly raised and not very distant from each other. Lateral expansions of the frontal carinae narrow. Head anterolaterally with a short, longitudinal carina. Genal carina absent. Gular area not impressed. Eyes small and represented by a light pigmented dot under the integument recognisable in the middle of the sides of the head. First funicular joint 1/2 longer than broad. Funicular joints 2-10 longer than broad. Last funicular joint slightly shorter than the sum of joints 8-10. Scapes long and slender, reaching the vertexal margin. Antennal torulus behind the lateral border of the clypeus. Masticatory margin of the mandibles with 5-6 denticles before the pointed apical tooth. Palp formula 4,3.

Mesosoma longer than the head length (mandibles included). Promesopleural and meso-metapleural sutures impressed ventrally only. Propodeal dorsum between basal and declivous faces slightly concave, weakly carinate, the carina interrupted medially. Each side of the declivous face of the propodeum with a semitransparent lamella, the lamella broader on the posterior half. Propodeal spiracle round and placed over the mid height in lateral view.

Petiole in side view convex on the two posterior thirds, with the sides diverging on the anterior third and convex posteriorly in dorsal view. Anterior border of the petiole gently concave and carinate, the carina weakly denticulate on each side. Ventral process of the petiole lamelliform, triangular and curved backwards. Postpetiole anteriorly as broad as the petiole; its sides gently diverging and weakly convex posteriorly. Postpetiolar sternite anteromedially with a marked triangular projection. Posterior half of the postpetiolar sternite convex. Constriction between postpetiole and first gas-

tral segment impressed. Gastral tergite I gently tumuliform on the curvature.

Legs slender. All tibiae with a pectinate spur. Spurs of fore legs with a basal spine. Fore basitarsi as long as the mid ones. Hind basitarsi about 1/7 shorter than hind tibiae. Second tarsomere of hind leg longer than the pretarsus. Pretarsal claws simple. Arolia absent.

Sculpture. Head, mesosoma, petiole and postpetiole punctate and with very thin, irregular and variably distributed rugulae. First gastral tergite superficially shining and covered by minute, piligerous punctures. Legs punctate.

Body covered by hairs of three main types: (1) short, dense, subdecumbent, over the whole body, sparse and suberect on the funicular joints; (2) longer than type (1), sparse and suberect over the whole body; (3) shorter than hair type (1), dense and decumbent on the funicular joints only. In addition the funicular joints bear whitish, thick, appressed, short, sparse hairs, and the scapes with sparse hairs similar to type (2) but shorter.

Colour light brown.

Measurements in mm and Indices: TL 4.64; HL 1.00; HW 0.84; EL 0.03; SL 0.81; WL 1.26; PeL 0.40; PeW 0.40; HFeL 0.96; HTiL 0.82; HBaL 0.71; LS4 0.40; LT4 1.16; CI 84.0; SI 81.0; IGR 0.34.

*Gyne*. Differing from the worker in the following details: eyes about 1/7 of the head length and with well defined ommatidia. Ocular pilosity present. Ocelli present.

Mesosoma robust. Scutellum slightly shorter than the basal face of the propodeum; its sides gently converging into a convex posterior border. Metanotum with a small tooth. Propodeal lamellae slightly narrower.

Postpetiole anteriorly slightly broader than the petiole and with gently convex sides.

Sculpture. Pronotum, basal face of the propodeum, petiole and postpetiole with additional small, irregular foveae.

Measurements in mm and Indices: TL 5.53-5.78; HL 1.10; HW 0.98-1.00; EL 0.15-0.16; SL 0.87-0.89; WL 1.56; PeL 0.45-0.52; PeW 0.48-0.51; HFeL 1.08; HTiL 0.92-0.93; HBaL 0.82-0.84; LS4 0.44; LT4 1.52; CI 89.1-90.9; SI 79.1-80.9; IGR 0.29-0.30.

MATERIAL EXAMINED: UNITED STATES: TEXAS: Val Verde Co., Emerald Sink, 3.XI.1984, 1 worker (paratype), J. Reddell & M. Reyes [MCZC]; Texas, Terrell Co., Blackstone Cave, 5.II.1967, 1 gyne (paratype), D. McKenzie & D. Erickson [MCZC]. MEXICO: COAHUILA: 15 mi NW Cd. Acuña, Cueva de los Lagos, 27.I.1966, 1 gyne (paratype), J. H. Reddell [LACM].

DISCUSSION. *P. compitale* is the sister species of a species newly described in this paper, *creek*. *Compitale* and *creek* share by synapomorphy the gaster angulate on the curvature and the first funicular joint 1/2 longer than broad.

DISTRIBUTION: United States and Mexico.

***Proceratium creek* de Andrade n. sp.**

Figs. 86, 87, 88, 89

TYPE MATERIAL: holotype worker from Georgia, United States, labelled: "Georgia: Thomas Co., S. Thomasville, 1.8 mi. S. jct Metcalf Rd. & Springhill Rd., 10-17-XII-1996, P. Skelley & P. Kovarik, *Geomys* burrow pitfall", in MCZC; three paratype workers, same data as the holotype, one in MCZC, one in LACM and one in ABSC.

DERIVATIO NOMINIS: this species is named after the Creeks, an Indian tribe from Georgia.

DIAGNOSIS. A *Proceratium* species belonging to the *pergandei* clade and differing from its sister species, *compitale* (q. v.), by its larger size and allometric growth of some body parts.

DESCRIPTION. *Worker* (Fig. 86). Head longer than broad, its sides subparallel on the two anterior thirds and strongly converging on the posterior third. Vertexal margin convex. Anteromedian part of the clypeus rectangular and strongly protruding anteriorly. Anteromedian part of the clypeus dorsally with a variably marked inverted Y-shaped carina. Frontal carinae gently diverging posteriorly, slightly raised and not very close to each other.

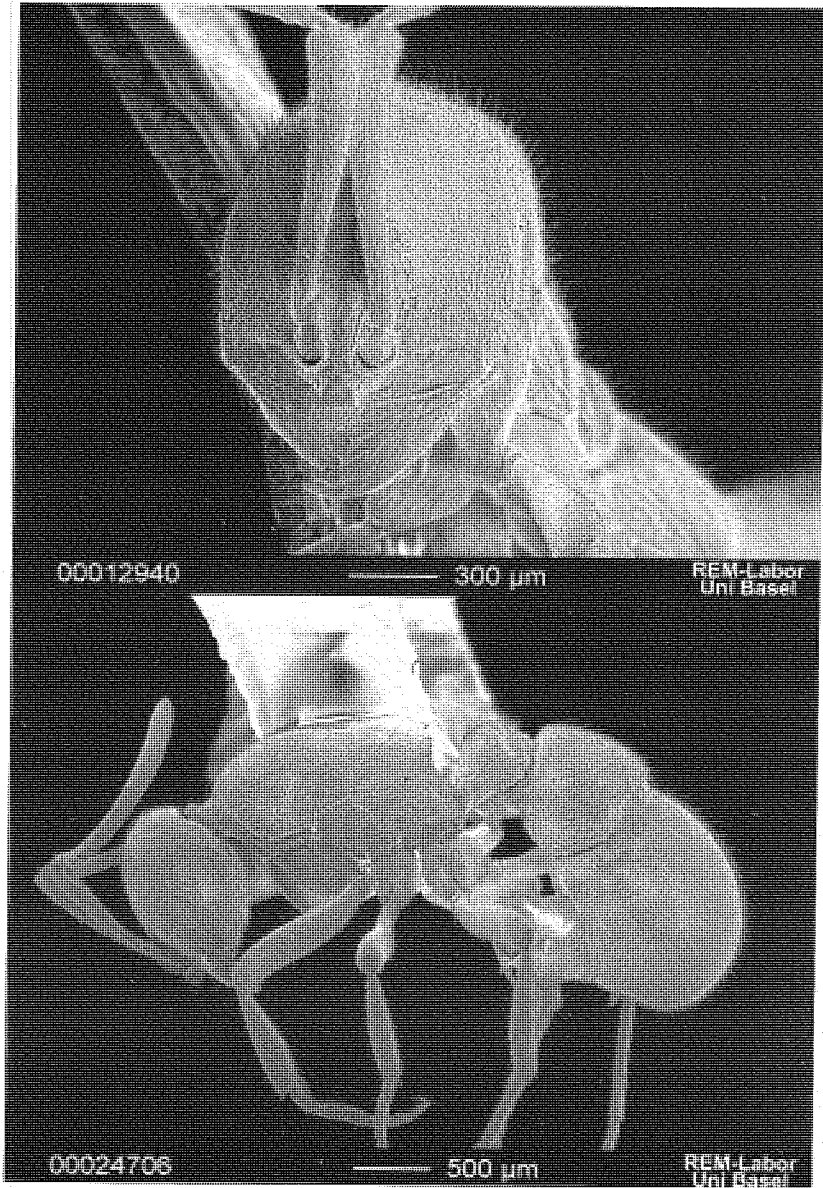


Fig. 86 – *Proceratium creek* de Andrade. Worker (paratype) from Thomas Co, S. Thomasville, Georgia, USA: head (top) in dorsal view and meso- and metasoma (bottom) in side view.



Lateral expansions of the frontal carinae narrow. Head anterolaterally with a short, longitudinal carina. Genal carina absent. Gular area not impressed. Eyes small and represented by a dark pigmented slightly differentiate integumental dot placed in the middle of the sides of the head. First funicular joint 1/2 longer than broad. Funicular joints 2-10 longer than broad. Last funicular joint slightly shorter than the sum of joints 8-10. Scapes long and slender, slightly surpassing the vertexal margin. Antennal torulus placed behind the lateral border of the clypeus. Masticatory margin of the mandibles with 5-6 denticles before the pointed apical tooth. Palp formula 4,3.

Mesosoma longer than the head length (mandibles included). Promesopleural and meso-metapleural sutures impressed ventrally only. Propodeal dorsum between basal and declivous faces marked by a concave carina. Declivous face of the propodeum with a semitransparent lamella on each side, the lamella denticulate on each side between the basal and declivous faces. Propodeal spiracle round and placed over the mid height in lateral view.

Petiole in side view convex on the two posterior thirds, with the sides diverging on the anterior third and convex posteriorly in dorsal view. Anterior border of the petiole gently concave and carinate, the carina weakly denticulate on each side. Ventral process of the petiole lamelliform, triangular and curved backwards. Postpetiole anteriorly as broad as or slightly broader than the petiole; its sides gently diverging and convex posteriorly. Postpetiolar sternite anteromedially with a marked triangular projection. Posterior half of the postpetiolar sternite convex. Constriction between postpetiole and first gastral segment impressed. Gastral tergite I feebly tumuliform on the curvature.

Legs slender. All tibiae with a pectinate spur. Spurs of fore legs with basal spine. Fore basitarsi as long as the mid ones. Hind basitarsi about 1/7 shorter than hind tibiae. Second tarsomere of hind legs longer than the pretarsus. Pretarsal claws simple. Arolia absent.

Sculpture. Head punctate and minutely rugulose, the punctures resembling minute reticulation close to the frontal carinae. Mesosoma, petiole, postpetiole and legs granulopunctate, the granulation slightly larger on the petiole and postpetiole. Metapleurae with additional, thin, rugosities. First gastral tergite superficially shining and covered by minute, piligerous punctures; its lateral and posterior border variably granulate. Legs punctate.

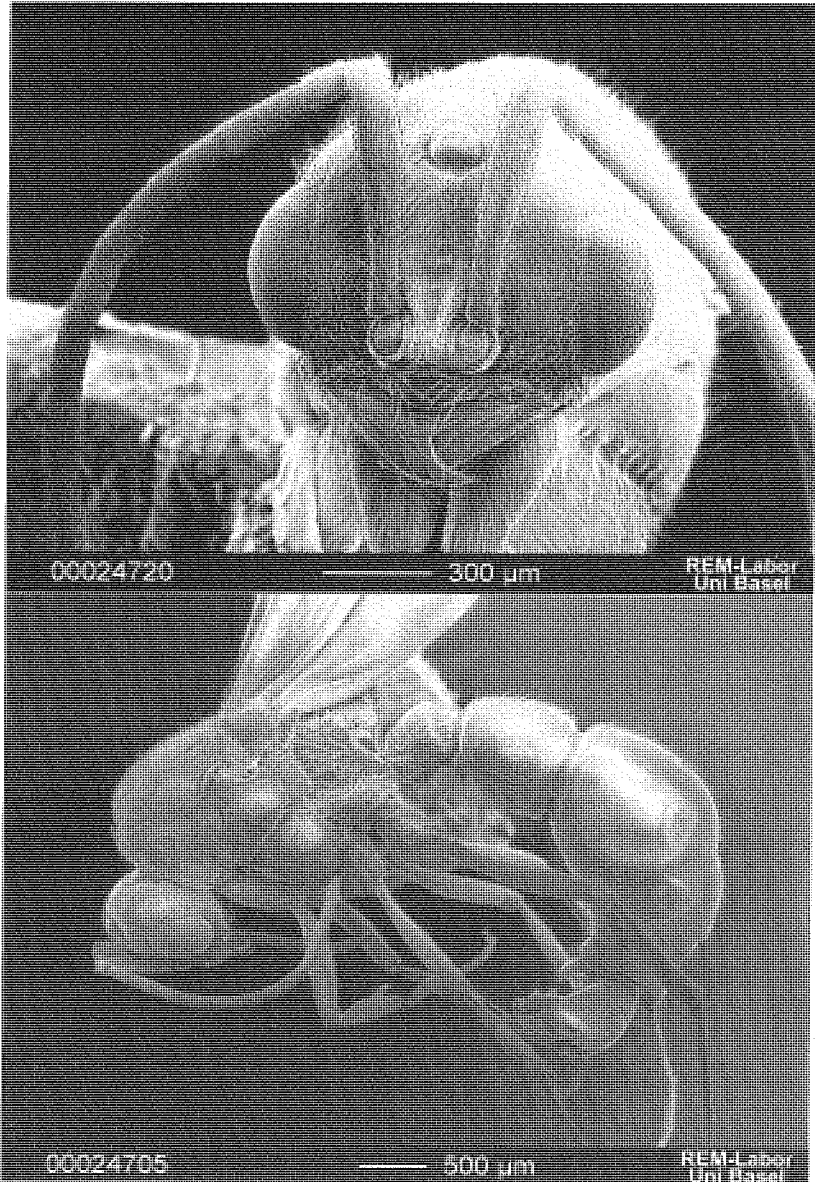


Fig. 87 – *Proceratium creek* de Andrade. Male from Leon Co., Tall Timbers Res. Station, Florida, USA: head (top) in dorsal view and meso- and metasoma (bottom) in side view.

Body covered by hairs of three main types: (1) short, dense, subdecumbent on the whole body, sparse and suberect on the funicular joints; (2) longer than type (1), sparse and suberect; (3) shorter than hair type (1), dense and decumbent on the funicular joints. In addition the funicular joints bear whitish, thick, appressed, short, sparse hairs, and the scapes with sparse hairs similar to type (2) but shorter.

Colour ferruginous-brown.

Measurements in mm and Indices: TL 5.50-5.70; HL 1.17-1.20; HW 0.94-0.98; EL 0.04-0.05; SL 0.96-1.00; WL 1.52-1.60; PeL 0.48-0.52; PeW 0.44-0.49; HFeL 1.22-1.26; HTiL 1.08-1.13; HBaL 0.90-0.96; LS4 0.42-0.45; LT4 1.32-1.40; CI 79.7-82.0; SI 81.3-83.3; IGR 0.31-0.33.

*Gyne*. Differing from the worker in the following details: eyes about 1/6 of the head length and with well defined ommatidia. Ocular pilosity present. Ocelli present.

Mesosoma robust. Scutellum shorter than the maximum length of the basal face; its sides gently converging into a convex posterior border. Metanotum with a tooth. Propodeal lamellae slightly narrower.

Postpetiole anteriorly slightly broader than the petiole.

Sculpture and pilosity as in the worker.

Measurements in mm and Indices: TL 6.68; HL 1.30; HW 1.04; EL 0.21; SL 1.06; WL 1.92; PeL 0.60; PeW 0.54; HFeL 1.42; HTiL 1.24; HBaL 1.10; LS4 0.52; LT4 1.74; CI 80.0; SI 81.5; IGR 0.30.

*Male* (tentative attribution) (Fig. 87). Head as broad as long. Vertex in full face view convex. Vertexal margin not carinate. Clypeus dorso-medially convex and with weakly convex anterior border. Frontal carinae thin, low and diverging posteriorly. Frontal area with sulcus. Ocelli large. Compound eyes large and placed mostly on the anterior part of the head sides. Scapes slightly surpassing the vertex. First funicular joint about 2/3 of the length of the second joint. Joints 2-11 longer than broad. Last funicular joint slightly shorter than the sum of joints 10-11. Mandibles with two, minute basal denticles and with a pointed apical tooth. Palp formula 5,3.

Mesosoma robust. Pronotum and anterior third of mesonotum almost perpendicular to the posterior two thirds of the mesonotum. Posterior two thirds of mesonotum weakly convex. Parapsidal furrows marked. Scutellum as high as the mesonotum; posterior border of scutellum round. Basal and

declivous faces of the propodeum very distinct. Sides of the basal face of the propodeum gently converging posteriorly and separated from the declivous face by a strong transversal carina forming a tooth on each side. Declivous face of propodeum laterally strongly carinate. Metanotum with a median spine-like projection. Propodeal lobes round. Propodeal spiracles small.

Petiole in side view declivous in the anterior third and convex in the two posterior thirds. Sides of the petiole in dorsal view gently diverging in the anterior third and convex in the two posterior thirds. Anterior border of the petiole concave and strongly carinate. Subpetiolar process subtriangular and lamelliform. Postpetiole anteriorly slightly broader than the petiole; postpetiolar sides weakly convex. Anterior border of the postpetiolar sternite with a superficial triangular "lip". Posterior half of the postpetiolar sternite gently convex. Gastral tergite I round. Gastral sternite I large. Remaining gastral tergites and sternites slightly curved ventrally.

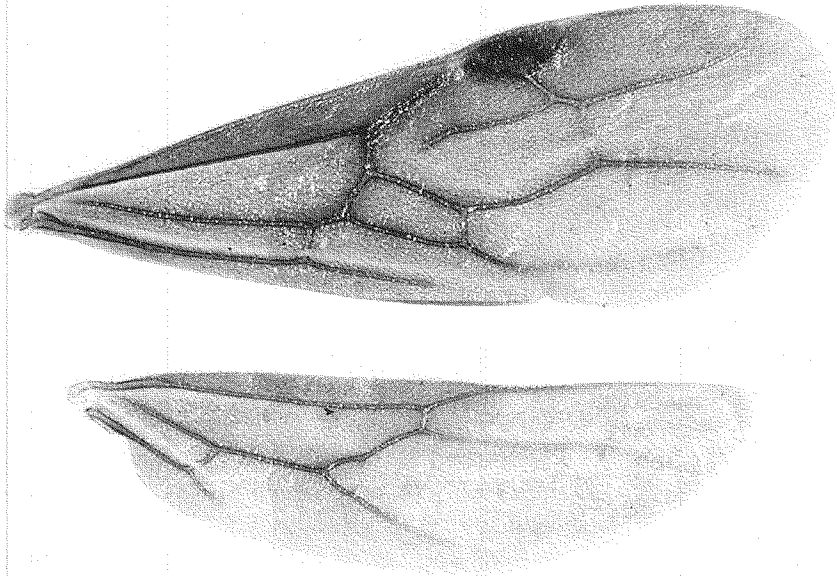


Fig. 88 – *Proceratium creek* de Andrade. Male from Leon Co., Tall Timbers Res. Station, Florida, USA: fore and hind wings.

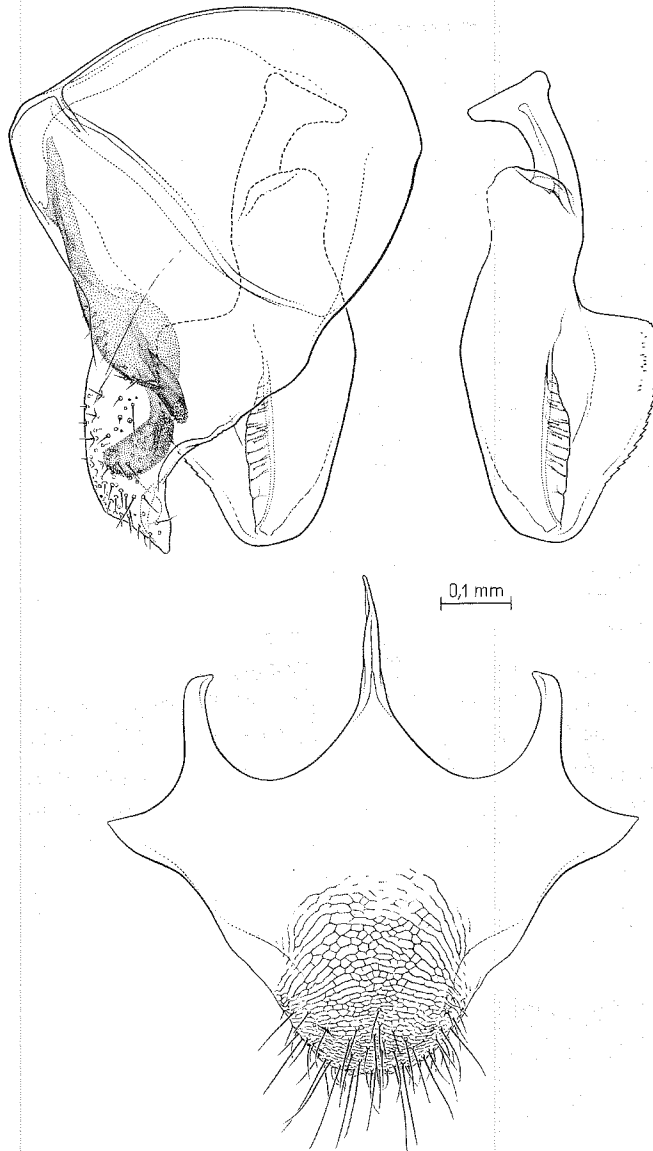


Fig. 89 – *Proceratium creek* de Andrade. Male from Leon Co., Tall Timbers Res. Station, Florida, USA. Genital appendages: a) lateral view of left parameres and of their relative positions; b) right aedeagus in profile; c) subgenital plate in ventral view.

Legs as in the worker but much more elongate.

Fore wings of our type 1, hind wings of our type 2 as defined in the description of the genus (Fig. 88).

Genitalia as in Fig. 89.

Sculpture. Head, mesosoma and scutellum punctate and rarely minutely granulate. Areas close to the antennal insertions and propleurae with additional thin, slightly longitudinal rugosities. Propodeum and petiole granulate and with thick, irregular rugosities. Postpetiole granulopunctate. Gaster and legs with minute punctures.

Pilosity as in the worker.

Colour. Light brown with lighter antennae and legs.

Measurements in mm and Indices: TL 5.65; HL 0.90; HW 0.90; EL 0.46; SL 0.68; WL 2.02; PeL 0.52; PeW 0.50; HFeL 1.28; HTiL 1.08; HBaL 1.00; LS4 0.76; LT4 1.26; CI 100.0; SI 75.5; IGR 0.60.

MATERIAL EXAMINED: UNITED STATES: GEORGIA: Thomas Co., S. Thomasville, 1.8 mi. S junction Metcalf & Springhill roads, 10-17.XII.1996, 4 workers (holotype MCZC & paratypes), P. Skelley & P. Kovarik [ABSC, LACM, MCZC]; same locality and collectors, 23.XI-1.XII.1996, 3 workers [ABSC]. ARKANSAS: Marion Co., 1 worker (mesosoma partially damaged), July, J. C. Bridwell [USNM]. FLORIDA: Lafayette Co., W. Branford, 0.1 mi. W jct. 475 & US-27, *Geomys* burrow pitfall, 22-24.II.1997, 1 worker, P. Kovarik & P. Skelley [ABSC]; same locality and collectors, 22-28.II.1997, *Geomys* burrow pitfall, 1 gyne [ABSC]; Leon Co., Tall Timbers Res. Station, 15-21.VIII.1983, malaise trap, 1 male, S. Gupta [ABSC].

DISCUSSION. The workers of *P. creek* are the largest of the *pergandei* clade.

DISTRIBUTION: United States.

**Proceratium watasei** (Wheeler)

Fig. 90

*Sysphincta watasei* Wheeler, 1906: 303, pl. 41, fig. 5, worker. Worker and gyne. Original description. Type locality: Okayama (Bizen) and Kamakaur (Sagami Gulf), Japan. Type material: not available for the present study.

*Sysphincta watasei* Wheeler, Emery, 1909: 362. Worker and gyne.

*Proceratium watasei* (Wheeler), Brown, 1958a: 248. First combination in *Proceratium*.

*Proceratium watasei* (Wheeler), Choi et. al., 1985: 459.

*Proceratium watasei* (Wheeler), Ogata, 1987: 107, figs. 22 (wings) & 29 (subgenital plate). Male.

*Proceratium watasei* (Wheeler), Onoyama & Ogata, 1989: 15, figs. 3.22, 3.25a (worker).

*Proceratium watasei* (Wheeler), JADG, 1998: figs. PCD 1328-10, PCD 1328-11, PCD 1328-12, 103022, 103025a. Worker.

*Proceratium watasei* (Wheeler), Onoyama & Yoshimura, 2002: 43, figs. 16-18, 53 (worker), 28-30, 54, 77, 78 (gyne), 43-46, 79, 80 (male), 64 (subgenital plate).

**DIAGNOSIS.** A *Proceratium* species belonging to the *pergandei* clade appearing as outgroup of *compitale* and *creek* but differing from both species, in the worker and gyne, by the first funicular joint 1/3 longer than broad instead of 1/2 longer than broad, by the funicular joints about as long as broad instead of longer than broad and by the gastral tergite I strongly round on the curvature instead of slightly angulate.

**DESCRIPTION.** *Worker* (Fig. 90). Head longer than broad, with sides subparallel in the two anterior thirds and strongly convex in the posterior third. Anteromedian part of the clypeus rectangular and strongly protruding anteriorly. Anteromedian part of the clypeus, dorsally, with a variably impressed inverted Y-shaped carina. Frontal carinae gently diverging posteriorly, slightly raised and not very close each other. Lateral expansions of the frontal carinae narrow. Head anterolaterally with a short, longitudinal carina. Genal carina absent. Gular area not impressed. Eyes small, composed by a dark dot below or within the integument. First funicular joint 1/3 longer than broad. Funicular joints 2-10 about as broad as long. Last funicular joint slightly shorter than the sum of joints 8-10. Scapes slightly short of the vertexal margin and gently thickening apically. Antennal torulus behind the lateral border of the clypeus. Masticatory margin of the mandibles with 5-6 denticles before the pointed apical tooth. Palp formula 4,3.

Mesosoma about as long as or slightly longer than the head (mandibles

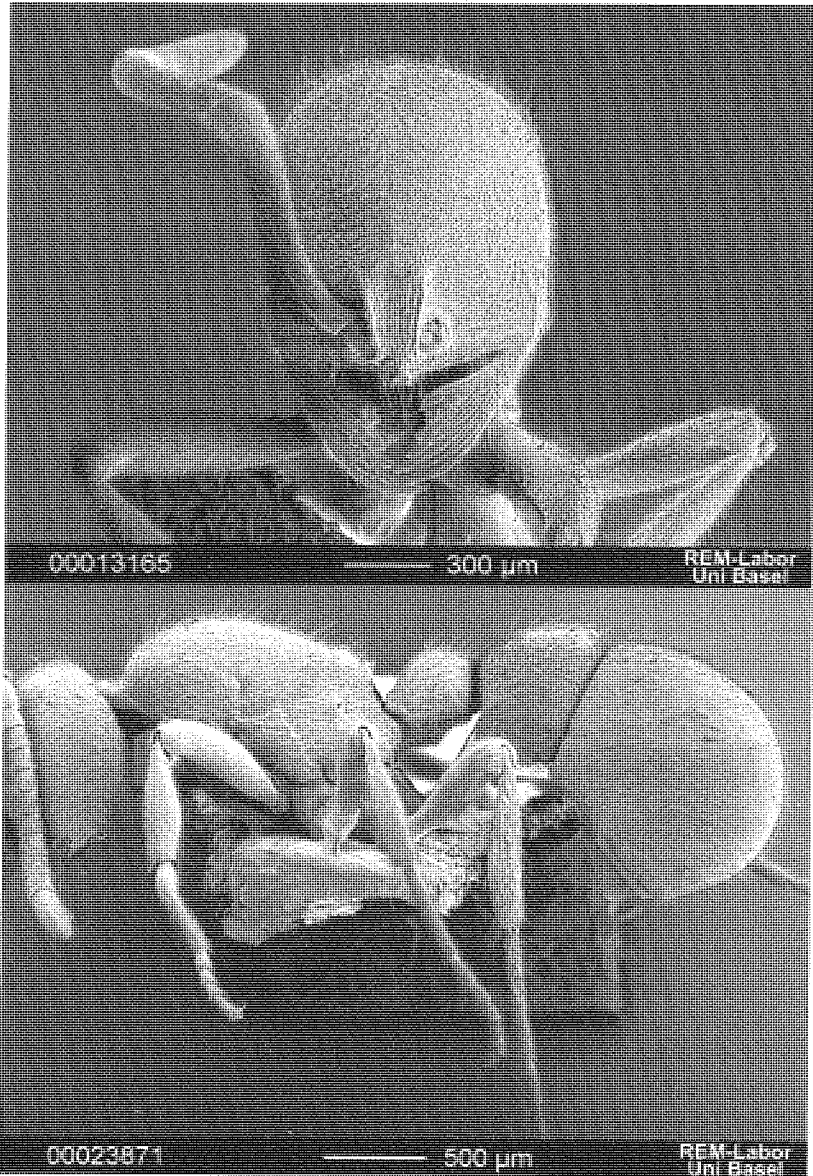


Fig. 90 – *Proceratium watasei* (Wheeler). Worker from Japan: head (top) in dorsal view from Futagotamagawa, Tokyo, and meso- and metasoma (bottom) in side view from Takarazuka, Hyogo.



included). Promesopleural and meso-metapleural sutures impressed ventrally only. Propodeal dorsum between basal and declivous faces slightly incised. Basal and declivous faces of the propodeum dorsally separated by a narrow lamella interrupted medially. Declivous face of the propodeum with a broad, semitransparent lamella on each side, the lamella slightly denticulate apically, broader on the posterior half. Propodeal spiracle round and over the mid height in lateral view.

Petiole convex in profile, with the sides diverging on the anterior third and strongly convex posteriorly in dorsal view. Anterior border of the petiole gently concave and carinate, the carina sometimes forming a denticle on each side. Ventral process of the petiole lamelliform, short and triangular. Postpetiole anteriorly as broad as the petiole; its sides diverging on the anterior half and gently convex on the posterior half. Postpetiolar sternite anteromedially with a marked subtriangular projection. Posterior half of the postpetiolar sternite convex. Constriction between postpetiole and first gastral segment impressed. Gastral tergite I strongly round and slightly recurved forwards.

Legs slender. All tibiae with a pectinate spur. Spurs of fore legs with basal spine. Fore basitarsi as long as the mid ones. Hind basitarsi about 1/7 shorter than hind tibiae. Second tarsomere of hind legs longer than the pretarsus. Pretarsal claws simple. Arolia absent.

Sculpture. Head, mesosoma, petiole and postpetiole minutely reticulate-punctate sparsely and irregularly rugulose, the reticulation broader, deeper and resembling irregular foveae in some parts of the mesosoma, petiole and postpetiole. Gaster superficially shining and covered by minute, piligerous impressions. Legs punctate.

Body covered by hairs of three main types: (1) short, dense, subdecumbent on the whole body, sparse and suberect on the funicular joints; (2) longer than type (1), sparse and suberect on the whole body, absent on the funiculi; (3) shorter than hair type (1), dense and decumbent on the funicular joints only. In addition the funicular joints bear whitish, thick, appressed, short, sparse hairs, and the scapes with sparse hairs similar to type (2) but shorter.

Colour dark ferruginous.

Measurements in mm and Indices: TL 4.68-5.20; HL 1.04-1.12; HW 0.87-0.96; EL 0.03-0.04; SL 0.81-0.89; WL 1.32-1.44; PeL 0.41-0.48; PeW

0.37-0.41; HFeL 0.96-1.08; HTiL 0.81-0.90; HBaL 0.68-0.80; LS4 0.39-0.41; LT4 1.08-1.22; CI 83.6-85.7; SI 78.0-79.5; IGR 0.34-0.36.

*Gyne*. Differing from the worker in the following details: eyes about 1/7 of the head length and with well defined ommatidia. Ocular pilosity present. Ocelli present.

Mesosoma robust. Scutellum as long as the sides of the basal face of the propodeum; its lateral parts gently converging into a convex posterior border. Metanotum without denticle. Propodeal lamellae dorsally connected.

Fore wings of our type 1, hind wings of our type 2 as defined in the description of the genus.

Measurements in mm and Indices: TL 5.60; HL 1.16; HW 1.00; EL 0.16; SL 0.91; WL 1.62; PeL 0.48; PeW 0.46; HFeL 1.14; HTiL 0.95; HBaL 0.83; LS4 0.55; LT4 1.46; CI 86.2; SI 78.4; IGR 0.38.

*Male*: Not available for the present study.

MATERIAL EXAMINED: JAPAN: HONSHU: Futagotamagawa, Tokyo, 19.IV.1950, 1 worker, A. Haga [MCZC]; Takarazuka, Hyogo Pref., 22.VI., 17.VII.1974, 2 workers, M. Tanaka [NHMB]; Manazuru, Kanagawa Pref. 9.IV.1978, 1 worker, M. Kubota [NHMB]; Otsu, 17.VII.1925, 1 gyne, Silvestri [LACM]; Nara, Nara Park, 8.VIII.1980, 1 worker, I. Löbl [MHNG].

DISCUSSION. Emery (1909) writes that the closest species to *watasei* is *algericum*. Both closer species, *compitale* and *creek* were unknown to Emery, of course.

According to JADG (1998) *watasei* lives in the soil of glossy-leaved evergreen forests. Choi et al. (1985) report the presence of *watasei* in the Korean peninsula.

DISTRIBUTION: Japan and Korea.

## **Proceratium algericum** Forel

### Fig. 91

*Proceratium (Sysphingta) algericum* Forel, 1899: 305. Worker. Original description. Type locality: Laverdure, Algeria. Type material: holotype worker labelled: "Laverdure, env. 1000 mètres sous pierre (Algérie) (Forel), *S. algerica* Forel, type" in MHNG, examined.

*Proceratium (Sysphingta) mayri* Forel, 1899: 306. Worker. Original description. Type locality: Corfu, Greece. Type material: three syntype workers labelled: "Corfu, J. Sahlb. Typus, *Sysphincta mayri* For.", 2 in MHNG, 1 in MCSN, examined. Synonymy with *algericum* by Baroni Urbani, 1977: 92.

*Sysphincta mayri* (Forel), Emery 1909: 361, fig. 2 a, worker. Worker and gyne. First combination in *Sysphincta*.

*Sysphincta algerica* (Forel), Emery 1909: 362, fig. 2 c. Worker. First combination in *Sysphincta*.

*Sysphincta mayri* Forel, Emery 1915: 250.

*Sysphincta Mayri* Forel, Emery, 1916: 102, fig. 12a. Worker.

*Sysphincta Mayri* Forel, Menozzi, 1921: 25.

*Sysphincta algerica* (Forel), Santschi 1929: 139. Gyne.

*Proceratium algericum* (Forel), Brown, 1958a: 247. First combination in *Proceratium*.

*Proceratium mayri* Forel, Baroni Urbani, 1964: 26.

*Proceratium algericum* Forel, Baroni Urbani, 1977: 92.

**DIAGNOSIS.** A *Proceratium* species belonging to the *pergandei* clade and differing from its in-group species *watasei*, in the worker and gyne, by the much more superficial sculpture and lighter colour, and from the two out-group species, *pergandei* and *chickasaw*, in the worker and in the gyne, by the gaster strongly convex on the curvature instead of angulate on the curvature.

**DESCRIPTION.** *Worker* (Fig. 91). Head longer than broad, with sides subparallel in the two anterior thirds and strongly convex in the posterior third. Anteromedian part of the clypeus rectangular and strongly protruding anteriorly, dorsally with a variably impressed, inverted Y-shaped carina. Frontal carinae diverging in the anterior half and subparallel in the posterior half, slightly raised and not very close to each other. Lateral expansions of the frontal carinae narrow. Genal carina absent. Gular area not impressed. Eyes small, in small specimens represented by a weakly pigmented dot below the integument and in larger specimens by a dark dot within the integument. First funicular joint 1/3 longer than broad. Funicular joints 2-10 about as broad as long. Last funicular joint slightly shorter than the sum of the joints 8-10. Scapes much short of the vertexal margin and gently thickening api-

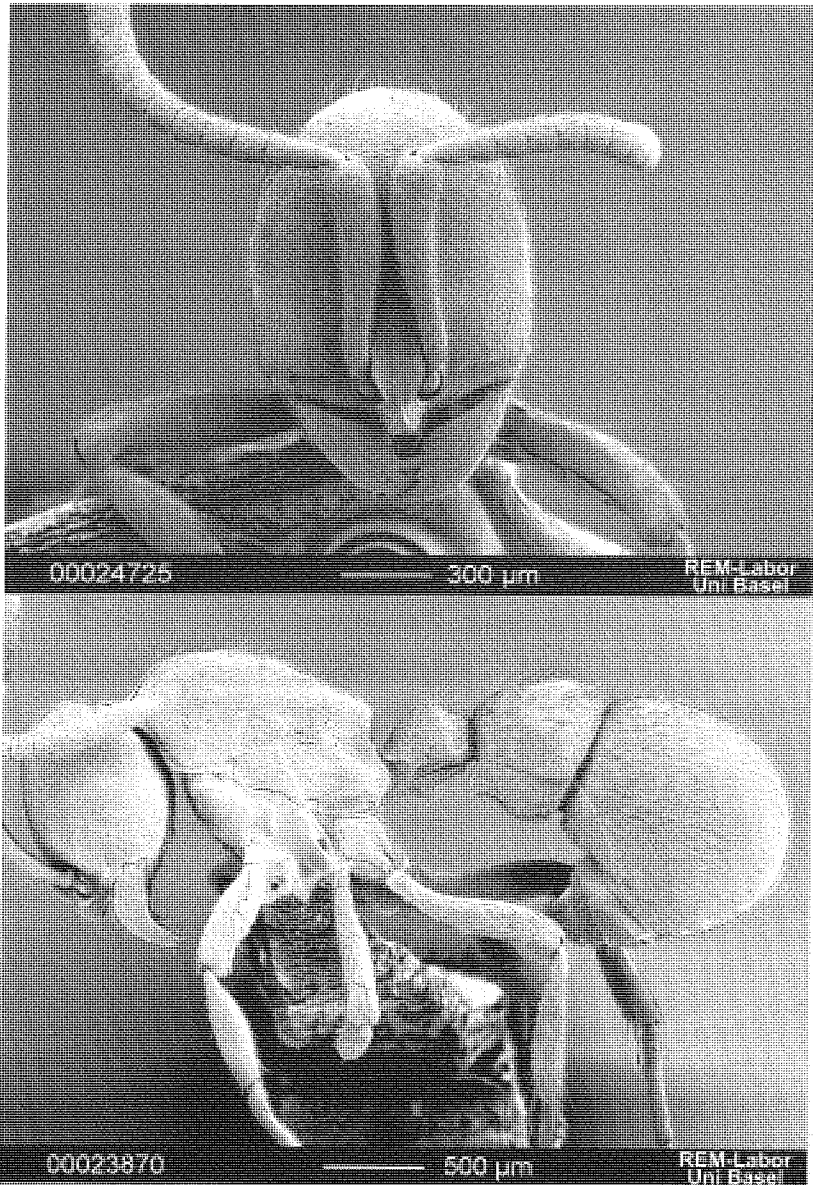


Fig. 91 – *Proceratium algiricum* (Forel). Worker from Corfu, Greece: head (top) in dorsal view and meso- and metasoma (bottom) in side view.

cally. Antennal torulus behind the lateral border of the clypeus. Outer face of the mandibles convex. Masticatory margin of the mandibles with 3-4 denticles before the pointed apical tooth. Palp formula 4,3.

Mesosoma about as long as the head (mandibles included). Promesopleural and meso-metapleural sutures impressed ventrally only. Propodeal dorsum between the basal and declivous faces slightly incised. Basal and declivous faces of the propodeum dorsally separated by a carina, the carina sometimes interrupted medially. Declivous face of the propodeum with a semitransparent lamella on each side, the lamella sometimes denticulate apically, broader on the posterior half. Propodeal spiracle round and over the mid height in lateral view.

Petiole convex in profile, with the sides diverging on the anterior fourth and strongly convex posteriorly in dorsal view. Anterior border of the petiole gently concave and carinate, the carina sometimes forming a denticle on each side. Ventral process of the petiole lamelliform, triangular. Postpetiole anteriorly as broad as or slightly broader than the petiole; its sides convex. Postpetiolar sternite anteromedially with a marked subtriangular projection. Posterior half of the postpetiolar sternite convex. Constriction between postpetiole and first gastral segment impressed. Gastral tergite I strongly convex on the curvature. Remaining gastral tergites and sternites curved ventrally.

Legs slender. All tibiae with a pectinate spur. Spurs of fore legs with basal spine. Fore basitarsi as long as the mid ones. Hind basitarsi about 1/6 shorter than hind tibiae. Second tarsomere of hind legs longer than the pretarsus. Pretarsal claws simple. Arolia absent.

Sculpture. Head, mesosoma, petiole and postpetiole minutely punctate and sparsely rugulose. Gaster superficially shining and covered by minute, piligerous impressions. Legs punctate.

Body covered by hairs of three main types: (1) short, dense, subdecumbent on the whole body, sparse and suberect on the funicular joints only; (2) longer than type (1), sparse and suberect on the whole body, absent on the funiculi; (3) shorter than hair type (1), dense and decumbent on the funicular joints only. In addition the funicular joints bear whitish, thick, appressed, short, sparse hairs, and the scapes with sparse hairs similar to type (2) but shorter.

Colour light brown.

Measurements in mm and Indices: TL 4.31-5.20; HL 0.97-1.14; HW 0.84-1.02; EL 0.03-0.05; SL 0.73-0.91; WL 1.16-1.46; PeL 0.37-0.45; PeW 0.37-0.43; HFeL 0.83-1.02; HTiL 0.72-0.90; HBaL 0.60-0.78; LS4 0.36-0.44; LT4 1.02-1.28; CI 84.1-89.5; SI 74.2-79.8; IGR 0.32-0.37.

*Gyne*. Differing from the worker in the following details: eyes about 1/7 of the head length and with well defined ommatidia. Ocular pilosity present. Ocelli present.

Mesosoma robust. Scutellum small and shorter than the sides of the basal face of the propodeum; its sides gently converging into a convex posterior border. Metanotum with a minute denticle. Propodeal lamellae narrower.

Sculpture. Pronotum, basal face of the propodeum and petiole with additional, superficial, sparse, slightly irregular, small, foveae-like depressions. Gaster with denser and larger piligerous impressions.

Measurements in mm and Indices: TL 5.42; HL 1.10; HW 0.95; EL 0.16; SL 0.82; WL 1.48; PeL 0.41; PeW 0.45; HFeL 0.98; HTiL 0.80; HBaL 0.70; LS4 0.45; LT4 1.42; CI 86.4; SI 74.5; IGR 0.32.

MATERIAL EXAMINED: ITALY: SICILY: Cava Grande near Avola (Siracusa), 20.IV.1962, 1 worker, M. La Greca [MSNV]. CROATIA: Dalmatia, no further locality, 2 workers, Kaufmann [MCSN, MHNW]. GREECE: Ithaki, Anoghi, 500 m, 19.IV.1972, 1 worker, Hauser [MHNG]. CORFU: Corfu, 3 workers (syntypes of *P. mayri*), J. Sahlberg [MCSN, MHNG]; Corfu, 11.IV.1972, 2 workers, B. Hauser [MHNG, NHMB]; Corfu, 1 worker, Moczarski [MCZC]; Lagune, 1905, 1 worker, O. Leonhard [DEIC]; Gasturi, 1905, 1 worker, O. Leonhard [MCSN]; Gasturi, 2.IV.1929, 2 workers [LACM, MCZC]; Potamos, 1.IV.1929, 2 workers, Beier [MCZC]. ARCADIA: Menalon, 1 worker, Weirather [MHNG]. TUNISIA: Le Kef, X. 1934, 2 workers, 1 gyne, Normand [NHMB]. Aïn-Draham, V.1934, 2 workers, Normand [NHMB]. ALGERIA: Laverdure, 1000 m, 1 worker (holotype), Forel [MHNG]. MOROCCO: Tarfaya, 1 worker, Thery [MCSN].

DISCUSSION. This species is very close to the Japanese and Korean *watasei*. The two species can nonetheless be separated by the difference in microsculpture, punctuated in *algoricum* and deeper, granulate in *watasei*. According to the material that we were able to see even the yellow-brown col-

oration of *algiricum* vs. the dark reddish of *watasei* should represent a clear character for the quick separation of the two.

During the present study we were able to re-examine Baroni Urbani's (1964) record from South Italy and to confirm it. The current record of the related species *melitense* (q. v.) from Sicily might cast some doubts on other, plausible literature records from geographically close localities that we were unable to verify. These are: Messina (Sicily, Emery, 1909); Reggio (Calabria, Emery, 1916); Monte Sant'Elia (Calabria, Menozzi, 1921).

DISTRIBUTION: Croatia, south Italy, Greece, Algeria, Morocco and Tunisia.

### **Proceratium pergandei** (Emery)

Figs. 92, 93, 94, 95, 96, 97

*Sysphincta pergandei* Emery, 1895: 264, pl. 8, fig. 4. Worker. Original description. Type locality: Beatty (Pennsylvania) and Washington D.C., USA. Type material: one syntype worker labelled: "Beatty, Pa, no. 175, Typus" in MCSN; one syntype worker labelled: "Washgtn, June 5 DC, Typus, *Sysphincta pergandei* Em" in MCSN; one syntype worker labelled: "Washgnt, 6.14 DC, no. 175, cotypus, *S. pergandei* Em" in MHNG, all examined.

*Sysphincta pergandei* Emery, Emery, 1896: 101, fig. 1. Worker.

*Sysphincta pergandei* Emery, Emery, 1911: pl. 2, fig. 6. Worker.

*Sysphincta pergandei* Emery, Smith, 1928: 242. Male.

*Sysphincta pergandei* Emery, Buren, 1944: 279.

*Sysphincta pergandei* Emery, Smith, 1947: 532, pl. 2, fig. 7. Worker.

*Sysphincta pergandei* Emery, Creighton, 1950: 42, pl. 4, figs. 1, 2. Gyne and worker.

*Proceratium pergandei* (Emery), Brown, 1958a: 248, fig. 23. Worker. Partim. Nec page 336, workers from Tennessee (= *chickasaw*). First combination in *Proceratium*.

*Sysphincta pergandei* Emery, Krafchick, 1959: pl.II fig. 10, pl. III fig. 13, pl. IV fig. 10. Male genitalia.

*Proceratium pergandei* (Emery), Snelling, 1967: 9. Identification key for workers and gynes.

*Proceratium pergandei* (Emery), Ward, 1988: 117. Identification key for workers and gynes.

DIAGNOSIS. A *Proceratium* species belonging to the *pergandei* clade and differing from its sister species *chickasaw* by the postpetiole densely and strongly granulate instead of superficially granulate, by the shorter gaster

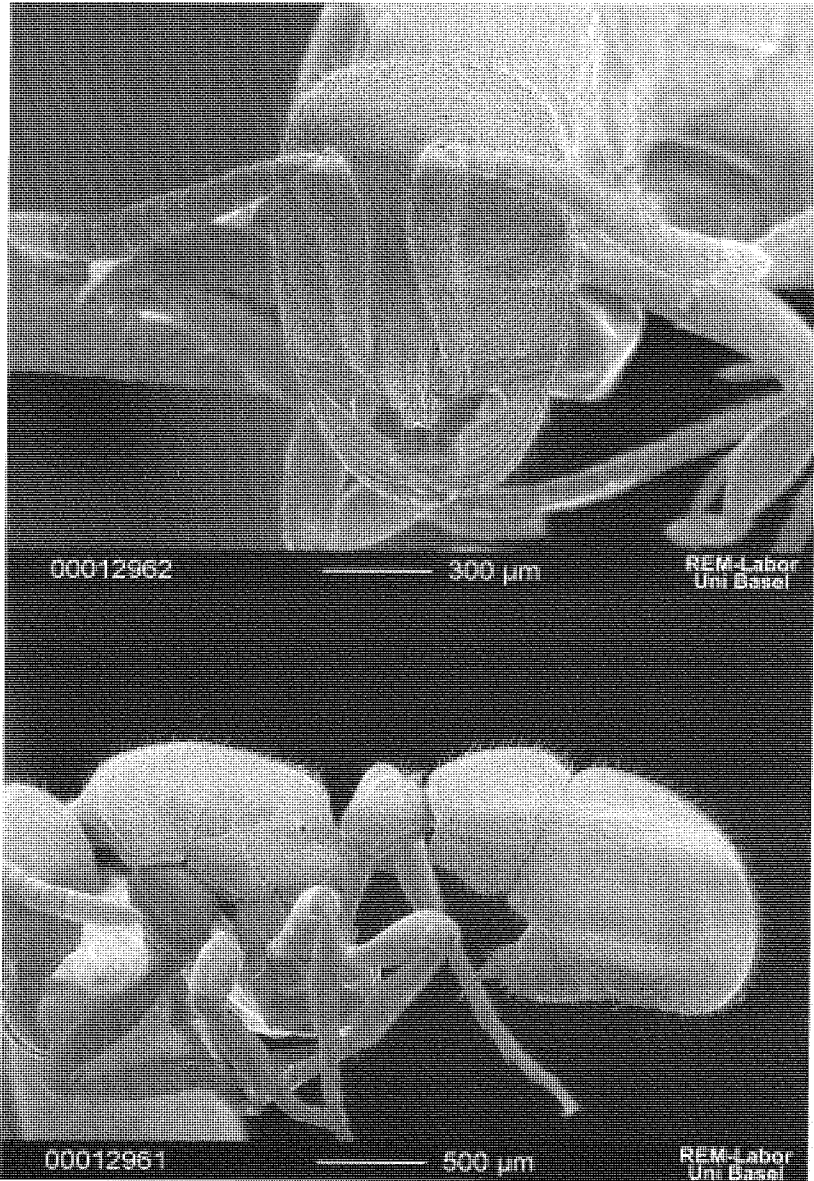


Fig. 92 – *Proceratium pergandei* (Emery). Worker from Black Pond, Virginia, USA: head (top) in dorsal view and meso- and metasoma (bottom) in side view.



(IGR 0.26-0.31 instead of 0.24-0.26), and by the gaster with denser and shorter hairs.

DESCRIPTION. *Worker* (Figs. 92 & 93). Head longer than broad, its sides subparallel in the two anterior thirds and gently converging in the posterior third. Anteromedian part of the clypeus rectangular, strongly protruding anteriorly and with a variably marked inverted Y-shaped carina dorsally. Frontal carinae diverging posteriorly, slightly raised and not very close each other. Lateral expansions of the frontal carinae narrow. Genal carina absent. Gular area not impressed. Eyes small, in small specimens they are represented by a dark dot below the integument and in larger specimens by a dot of about 8 weakly salient ommatidia. Eyes placed on the mid line of the head. First funicular joint  $1/5$  longer than broad. Anterior ocellus sometimes present. Funicular joints 2-10 as broad as long or slightly broader than long. Last funicular joint about as long as the sum of joints 8-10. Scapes much short of the vertexal margin and gently thickening distally. Antennal torulus behind the lateral border of the clypeus. Masticatory margin of the mandibles with 4-5 denticles before the pointed apical tooth. Palp formula 4,3.

Mesosoma as long as or slightly longer than the maximum head length (mandibles included). Promesopleural and meso-metapleural sutures impressed ventrally only. Basal and declivous faces of the propodeum separate by a carina sometimes interrupted medially. Declivous face of the propodeum with a relatively broad semitransparent lamella sometimes denticulate on each side between the basal and declivous faces. Propodeal spiracle round and above mid height in lateral view.

Petiole convex in profile, with the sides diverging on the anterior fourth and strongly convex posteriorly in dorsal view. Anterior border of the petiole straight or gently concave and variably carinate, the carina sometimes forming a denticle on each side. Ventral process of the petiole lamelliform, triangular and pointed. Postpetiole anteriorly as broad as or slightly broader than the petiole; its sides diverging, sometimes gently convex on the posterior half or on the whole sides. Postpetiolar sternite anteromedially with a marked subtriangular projection. Posterior half of the postpetiolar sternite convex. Constriction between postpetiole and first gastral segment impressed. First gastral tergite variably salient on the curvature. Remaining gastral tergites and sternites curved ventrally.

Legs slender but not very elongate. All tibiae with a pectinate spur. Spurs of fore legs with basal spine. Fore basitarsi longer than the mid ones. Hind basitarsi about 1/5 shorter than hind tibiae. Second tarsomere of hind leg longer than the pretarsus. Pretarsal claws simple. Arolia absent.

Sculpture. Head, mesosoma, petiole and postpetiole granulopunctate, the granulation more marked on the mesosoma, petiole and postpetiole. Gaster variably smooth and granulopunctate, the granulation variably marked.

Body covered by hairs of three main types: (1) short, dense, subdecumbent on the whole body, sparse and suberect on the funicular joints; (2) longer than type (1), sparse and suberect on the whole body, absent on the funiculi; (3) shorter than hair type (1), dense and decumbent on the funicular joints only. In addition the funicular joints bear whitish, thick, ap-

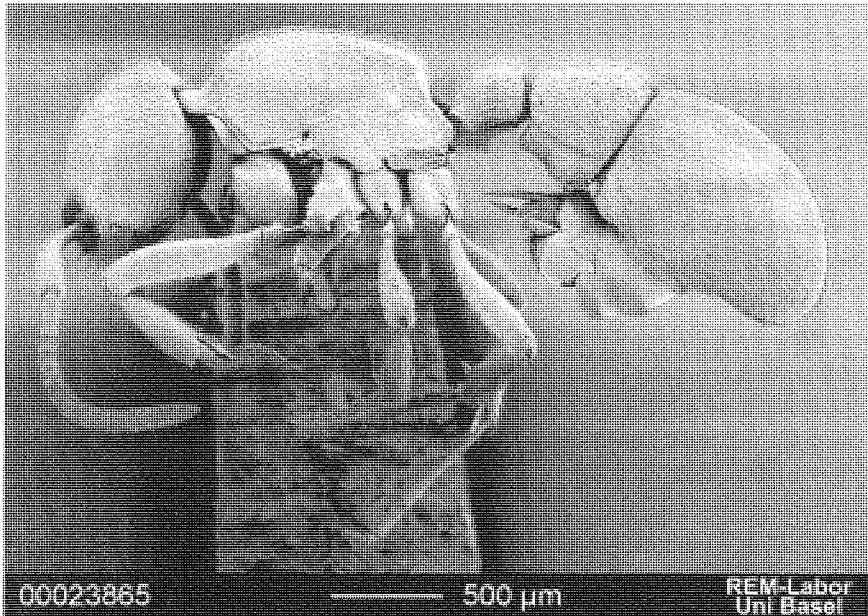


Fig. 93 – *Proceratium pergandei* (Emery). Worker from Grady Co., Beachton, Georgia, USA: meso- and metasoma in side view.

pressed, short, sparse hairs, and the scapes with sparse hairs similar to type (2) but shorter.

Colour light brown.

Measurements in mm and Indices: TL 3.58-4.68; HL 0.81-1.00; HW 0.69-0.87; EL 0.03-0.06; SL 0.54-0.68; WL 1.00-1.28; PeL 0.32-0.40; PeW 0.32-0.42; HFeL 0.62-0.86; HTiL 0.54-0.75; HBaL 0.43-0.60; LS4 0.27-0.38; LT4 0.89-1.22; CI 85.2-87.0; SI 66.7-68.7; IGR 0.26-0.31.

*Gyne* (previously undescribed). Differing from the worker in the following details: eyes about 1/6 of the head length and with well defined ommatidia. Ocular pilosity present. Ocelli present. Scapes slightly shorter.

Mesosoma robust. Scutellum large, longer than the basal face of the propodeum; its sides gently converging into a convex posterior border.

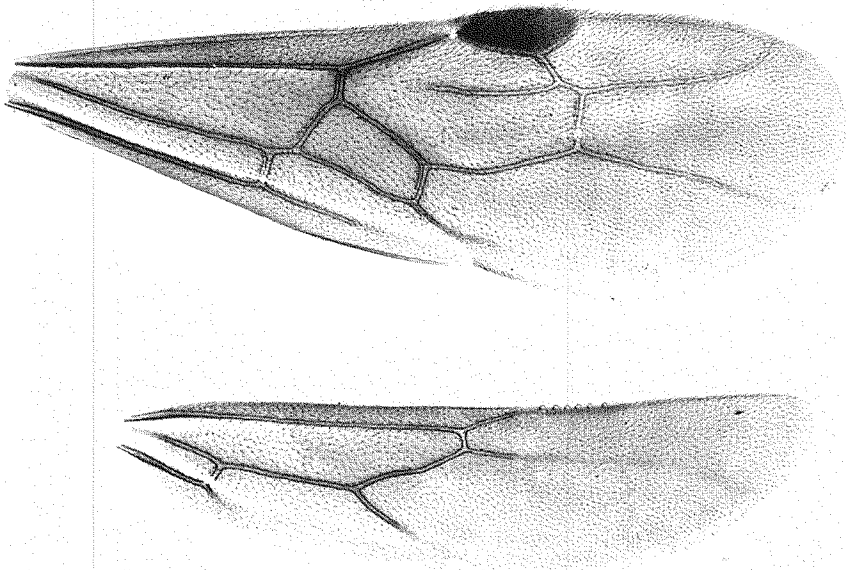


Fig. 94 – *Proceratium pergandei* (Emery). Gyne from Larimer Co., Dixon Res. Colorado, USA: fore and hind wings.

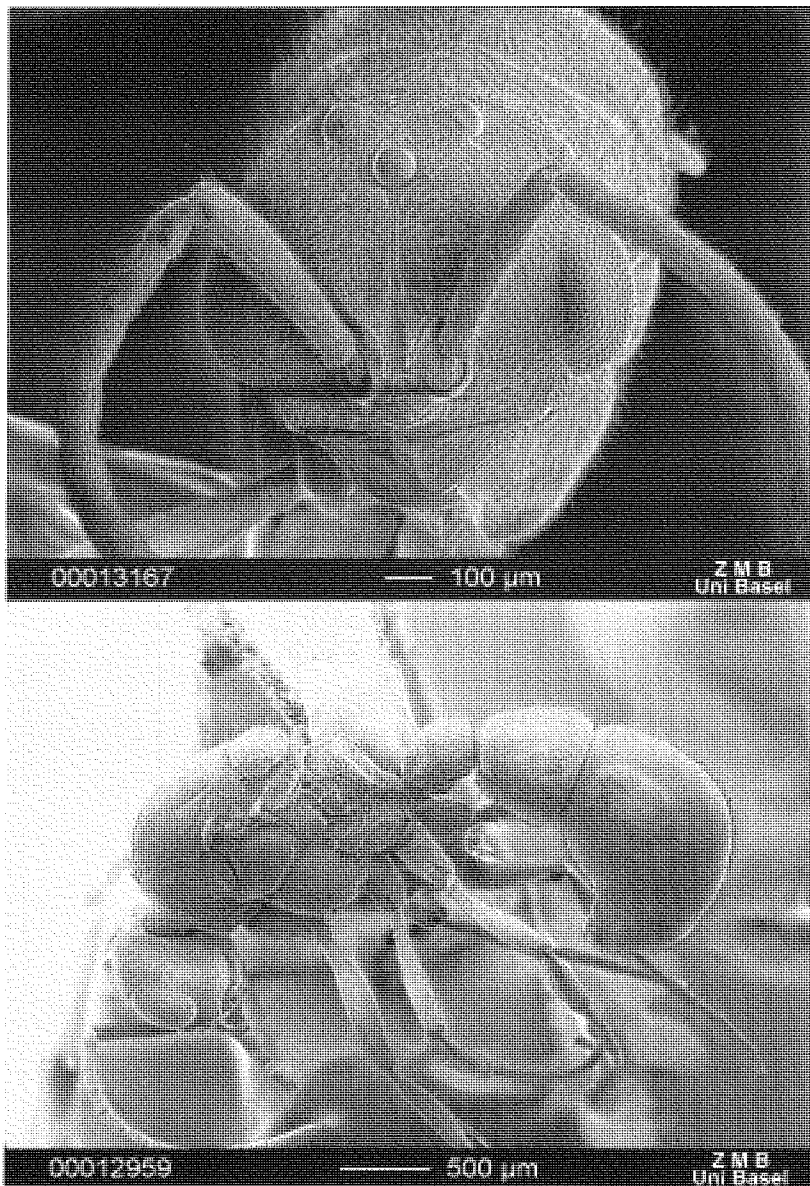


Fig. 95 – *Proceratium pergandei* (Emery). Male from Fairfax Co. nr. Annandale, Virginia, USA: head (top) in dorsal view and meso- and metasoma (bottom) in side view.

Metanotum sometimes with a small denticle. Median length of the basal face of the propodeum about half of the declivous face. Propodeal lamellae normally broad or narrower in some specimens.

Petiole slightly broader than long. Postpetiole anteriorly slightly broader than the petiole and with convex sides.

Fore wings of our type 1, hind wings of our type 2 as defined in the description of the genus (Fig. 94).

Measurements in mm and Indices: TL 4.87-5.10; HL 0.99-1.00; HW 0.86-0.88; EL 0.17-0.18; SL 0.66-0.67; WL 1.36-1.40; PeL 0.38-0.39; PeW 0.41-0.43; HFeL 0.82-0.86; HTiL 0.70-0.72; HBaL 0.58-0.62; LS4 0.39; LT4 1.32; CI 86.0-88.8; SI 66.7-67.0; IGR 0.30.

*Male* (Fig. 95). Head slightly broader than long. Vertex in dorsal view convex. Vertexal margin not carinate. Clypeus dorso-medially convex and with weakly convex or almost straight anterior border. Frontal carinae thin, low, diverging posteriorly. Frontal area with sulcus. Ocelli large. Compound eyes large and placed mostly on the anterior part of the head sides. Scapes reaching the anterior ocellus. First funicular joint about 2/3 of the length of the second joint. Joints 2-11 longer than broad. Last funicular joint slightly shorter or as long as the sum of joints 10-11. Mandibles edentate or with a minute denticle close to the base and only with a pointed apical tooth. Palp formula 5,3.

Mesosoma robust. Pronotum and anterior third of mesonotum almost perpendicular to the posterior two thirds of the mesonotum. Posterior two thirds of mesonotum nearly flat. Parapsidal furrows marked. Scutellum as high as the mesonotum; posterior border of scutellum round. Basal and declivous faces of the propodeum distinct. Sides of the basal face of the propodeum gently converging posteriorly and separate from the declivous face by a carina. Declivous face of propodeum laterally carinate. Metanotum with a median spine like projection. Propodeal lobes round. Propodeal spiracles small.

Petiole declivous in the anterior third and convex in the two posterior thirds in profile. Sides of the petiole parallel in the anterior third and convex in the two posterior thirds in dorsal view. Anterior border of the petiole concave and carinate. Subpetiolar process small, subtriangular and lamelliform. Postpetiole anteriorly slightly broader than the petiole; postpetiolar sides diverging or slightly convex posteriorly. Anterior border of the post-

petiolar sternite with a superficial triangular "lip". Posterior half of the post-petiolar sternite gently convex. Gastral tergite I round. Gastral sternite I large. Remaining gastral tergites and sternites slightly curved ventrally.

Legs as in the worker but more elongate.

Fore wings of our type 1, hind wings of our type 2 as defined in the description of the genus (Fig. 96).

Genitalia as in Fig. 97.

Sculpture. Head, mesosoma, petiole and postpetiole punctate and covered by small, foveae-like, dense reticulation, the reticulation less impressed on the ventral part of the head, on the upper mesopleurae and on the post-petiole, large on the basal face of the propodeum, irregular on the metapleu-

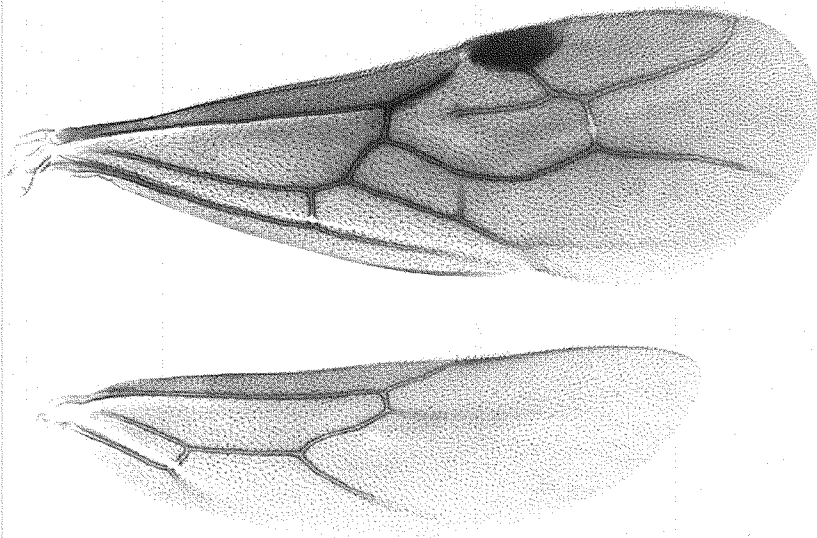


Fig. 96 – *Proceratium pergandei* (Emery). Male from Fairfax Co. nr. Annandale, Virginia, USA: fore and hind wings.

rae. Declivous face of the propodeum smooth and with striae converging posteriorly. Gaster smooth and with sparse, minute piligerous foveae. Legs superficially smooth and minutely granulate.

Pilosity as in the worker.

Colour. Dark brown to black with lighter antennae and legs.

Measurements in mm and Indices: TL 3.67-4.06; HL 0.64-0.69; HW 0.69-0.74; EL 0.35-0.38; SL 0.38-44; WL 1.36-1.48; PeL 0.34-0.38; PeW 0.33-0.36; HFeL 0.73-0.84; HTiL 0.64-0.70; HBaL 0.54-0.63; LS4 0.44-0.51; LT4 0.78-0.92; CI 107.2-108.8; SI 59.3-64.7; IGR 0.55-0.56.

MATERIAL EXAMINED: UNITED STATES: NEW YORK: Bronxville, 31.V.1908, 2 workers, W. M. Wheeler [MCZC]; Woodhaven, Queens Co., 5.VIII.1970, soil surface, 1 worker, S. P. Cover [MCZC]. MASSACHUSETTS: Forest Hill, 2.VI.1915, 1 worker, F. X. Williams [USNM]; Milton, 23.V, VI.1954, 2 workers, W. L. Brown, [LACM, USNM]. PENNSYLVANIA: no further locality, 4 workers, Schmitt [NHMW]; Beatty, 1 worker (syntype) [MCSN]; same locality, 1 worker (probably belonging to the type series) [MCZC]; same locality, 2 workers (USNM worker labelled as cotype), Schmitt [LACM, USNM]. NEW JERSEY: Short Hills, 8.VIII.1908, 1 worker, Wheeler [MCZC]. MARYLAND: near Plummers Island, 29.III.1927, 1 worker, H. S. Barber [USNM]. WASHINGTON D.C.: Washington, June 5 and 14, 2 workers (syntypes) [MCSN, MHNG]; same locality, June, 1 worker (probably belonging to the type series) [MCZC]; same locality, June 26-92, 1 worker (labelled as cotype) [USNM]; same locality, July 8, 2 workers (labelled as cotype), [LACM, USNM]; same locality, October 3, 1 worker (labelled as cotype) [USNM]. IOWA: Bellevue, 17.VII.1941, 1 worker, Wm. Buren [LACM]. COLORADO: Larimer Co., Dixon Res., 12.VIII:1994, 1 gyne, 1 male, D. Leatherman [MCZC]. KANSAS: Manhattan, 27.VIII.1940, collected from Vernonia interior Sm., 1 male, R. Schwitzgebel [USNM]. MISSOURI: St. Charles Co., 7.IX.1949, 3 workers, 1 gyne, M. Talbot [LACM, MCZC]. VIRGINIA: Great Falls, 1 worker, W. M. Mann [USNM]; Occoquan, 23-25.IV, 1 worker, W. M. Mann [USNM]; Black Pond, 6 workers [USNM]; Mt. Airy Farm, Albemarle Co., 10.IX.1958, 2 workers, J. Meem [MCZC]; Fairfax Co., near Annandale, 28.VII.1985, malaise trap, 2 males, D. R. Smith [USNM]. OKLAHOMA: Latimer Co., 15.V.1983, 2 workers, K. Stephan [ABSC, UCFC]. ARKANSAS: Dry Creek, Scott Co., 15.V.1992, 1 worker, H. Robison & C. Carlton [ABSC]. TENNESSEE:

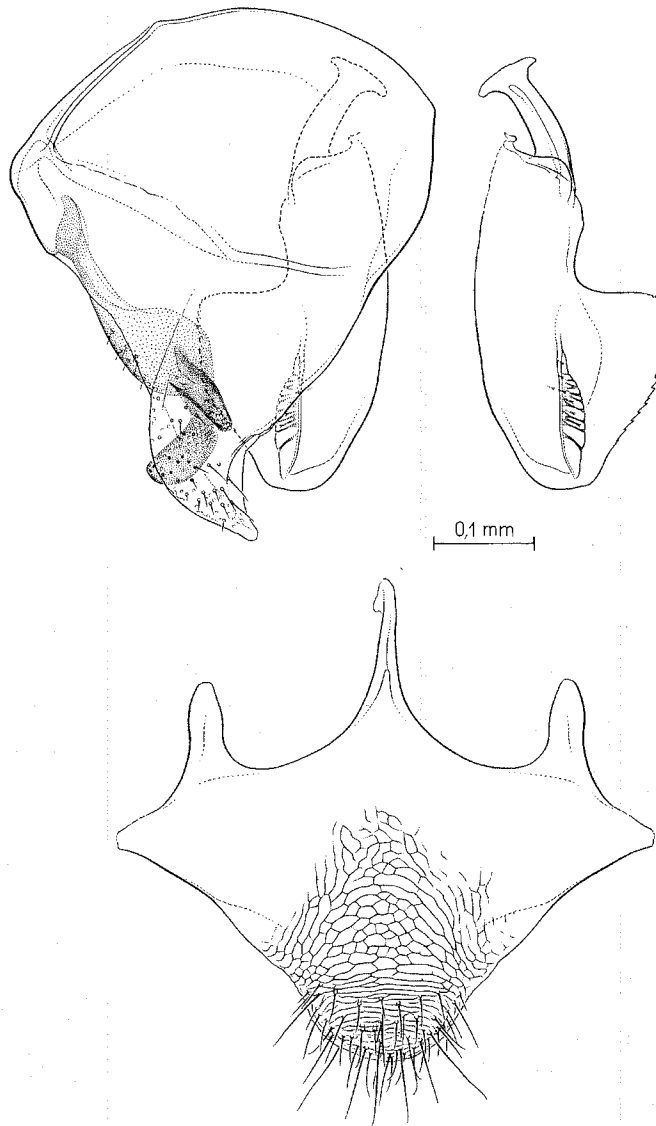


Fig. 97 – *Proceratium pergandei* (Emery). Male from Defuniak Springs, Walton Co., Florida, USA. Genital appendages: a) lateral view of left parameres and of their relative positions; b) right aedeagus in profile; c) subgenital plate in ventral view.



Chilhowee Mt., Servier Co., 21.X.1950, 1 worker, A. C. Cole [LACM]; Gt. Smoky Mountains, National Park, Ramsey Cascade Tr., 5.VII.1999, 1 worker, M. Deyrup & S. Cover [ABSC]. NORTH CAROLINA: Duke Forest, Durham, 14.VII.1933, 1 worker, A. S. Pearse [MCZC]. SOUTH CAROLINA: Clemson College, 1916, 1 worker, M. R. Smith [USNM]; Bank of South Santee River, Highway no. 17, 19.III.1946, 1 worker, W. S. Creighton [LACM]; 1 mi E Ravenel, Charleston Co., 9.VI.1957, 1 worker, W. L. Brown & E. O. Wilson [MCZC]. MISSISSIPPI: Louisville, 1 worker, M. R. Smith [USNM]; Corinth, 1 worker, M. R. Smith [USNM]. ALABAMA: Spring Hill, Mobile, 24.III.1950, 1 worker, E. O. Wilson [MCZC]. GEORGIA: Grady Co., Beachton, N, 0.2 mile W jct. Rt. 319 on Blackshear Rd., Pebble Hill Plantation, 23.I-21.III.1999, *Geomys burrow* pitfall, 10 workers, P. Kovarik, R. Turnbow & W. Baker [MCZC, MRSN]. TEXAS: Polk Co., 12.V.1988, leaf litter, 2 workers, R. Anderson [WEMC]; Houston Co., Big Slough Wild area, 9.V.1988, in litter, 3 workers, R. Anderson [WEMC]; Smith Co., Tyler State Park, in litter, 1 worker, R. Anderson [WEMC]; Bandera Co., Los Maples St. Nat. Area, 21.IV.1986, leaf litter, 4 workers, P. W. Kovarik [LACM]; Nacogdoches, 12 mi SSW Nacogdoches Co., 13.IV.1984, 1 worker, W. Suter [ABSC]. LOUISIANA: DeRidder, 25.VII.1942, 1 gyne, Wm. Buren [USNM]. FLORIDA: Gainesville, 4.I.1959, 1 gyne, K. W. Cooper [USNM]; Leon Co., Tallahassee, 10.I.1983, 1 worker, G. B. Marshall [LACM]; Tallahassee, Leon Co., 1.VII.1965, 1 worker, W. Suter [ABSC]; Tall Timbers Res. Station, Leon Co., 15-21.VIII.1989, malaise trap, 1 male, S. Gupta [ABSC]; Caverns St. Park, Jackson Co., 6.IV.1969, 3 workers, S. Peck [MCZC]; Alachua Co., Gainesville, 18-30.IX.1983, Rock Creek, malaise trap, 1 gyne, S. Gupta [ABSC]; Archbold Biological Station, Lake Placid, Highlands Co., 13.VII, 22 & 28.VIII.1983, 17.V.1985, 24.VII.1986, 14.VIII.1987, malaise trap, 10 males, M. Deyrup [ABSC, WEMC]; Walton Co., Eglin F. B., 28.IV.1999, 1 worker, M. Deyrup & S. Cover [ABSC]; Walton Co., Portland, 21.III.1993, 1 worker, L. R. Davis Jr. [MCZC]; Walton Co., Eglin AFB, 24 & 28.IV.1999, 2 workers, S. P. Cover & M. Deyrup [MCZC]; same locality, McQuage Branch Creek, 27.IV.1999, 1 worker, S. P. Cover [MCZC]; same locality, Alice Creek, 10.V.2000, 1 worker, S. P. Cover [MCZC]; Defuniak Springs, Walton Co., 9.VII.1989, 1 worker, M. Deyrup [ABSC]; same locality, 21-28.VII.1991, malaise traps in woods near stream, 2 males, Winegarner & Deyrup [ABSC]; Santa Rosa Co., Eglin AFB, 3.2 mi NE Jct. Rt. 87 on

Rd. 211 at Boiling Creek, 8.V.2000, 2 workers, 1 gyne, S. P. Cover [MCZC]; Brevard Co., Indian River City, 1.III.2001, in deep scrub oak leaf litter, Dicerandra Preserve, 1 worker, M. Deyrup & S. Cover [ABSC]; Levy Co., 3.9 mi SW of Archer, 13-19.X.1990, trough trap in Turkey oak and Rosemary sandhill habitat, 1 worker (without postpetiole and reduced gaster), Paul & Skelley [ABSC]; Dixie Co., 2 mile S Jena, rt. 361, 16.VII.1993, 1 worker, L. R. Davis Jr. [ABSC]; Putnam Co., 3 miles E Melrose, Ordway Preserve, 2.IX.1996, 1 gyne, L. R. Davis Jr. [ABSC]; Jungle Prado Park, Pinellas Co., 1.V.1993, 2 workers, J. Mangolo [ABSC]; 5 mi N Macclenny, Baker Co., 18.VIII.1965, hardwood swamp, 2 workers, W. Suter [ABSC]; Pine Barren, Escambia Co., 16.II.1992, dense pine & hardwood forest, 1 worker, M. Deyrup [ABSC]; Athena, Taylor Co., 27.VI.1965, moist forest, 1 worker, W. Suter [ABSC]; Hamilton Co., 2 mi of Jasper, 3.VII.1994, oak pine hammock near snake pond swamp, 1 worker, M. & S. Deyrup [ABSC], Nassau Co., 1 mi E Boulogne, 19.II-18.III.1997, *Geomys* burrow pitfall, 1 worker, Skelley, Turnbow et al. [ABSC]; Santa Rosa Co., 22 mi N of Harold, 1.III-10.IV.1999, S. boundary of Blackwater R. State For., pitfall trap in burrow of *Geomys*, 1 gyne, R. Turnbow & P. Kovarik [ABSC]; St. Johns Co., S Ponte Vedre Rec. Area, 27.XI.1993, 1 worker, 1 gyne, L. R. Davis Jr. [ABSC].

DISCUSSION. Wesson & Wesson (1940) kept under observation a colony of *pergandei* from Jackson (Ohio) comprising 1 gyne, 11 workers and 8 males. After many attempts to feed the colony on different types of insect food, the authors suggest that these ants may live on dead or dying ants at least in part. Talbot (1957) found in St. Charles (Missouri) a supposedly complete colony of *P. pergandei* comprising 1 gyne, 13 workers and 13 larvae.

The worker from Leon Co. (Florida), the one from Bank of South Santee River (South Carolina) and those from Grady Co. differs slightly from all the other workers of *pergandei* we examined by the gaster slightly longer and more angulate on the curvature (Fig. 93). Some workers from Washington D. C. have the gastral curvature more round (Fig. 92, bottom). All the workers from Texas have the sculpture slightly deeper than in the other specimens examined.

DISTRIBUTION: United States: New York, Ohio, Massachusetts, Pennsylvania, New Jersey, Maryland, Washington D.C, Iowa, Colorado, Kansas, Virginia, Oklahoma, Arkansas, Tennessee, North Carolina, South Carolina,

Alabama, Mississippi, Georgia, Texas, Louisiana, Florida. Other state records resulting from the literature but not verified by ourselves are not included. Most of them, however, appear perfectly plausible.

***Proceratium chickasaw* de Andrade n. sp.**

Figs. 98, 99

*Sysphincta pergandei* Emery, Wesson & Wesson, 1940: 90. Worker. Partim. Nec Emery, 1895. Misidentification.

*Proceratium pergandei* (Emery), Brown, 1958a: 336. Partim. Workers from Tennessee. Misidentification.

TYPE MATERIAL: holotype worker from Farmer, Polk County, Tennessee, USA, labelled: "Farmer, Polk Co., Tenn., V.25.51, E. O. Wilson, *Sysphincta pergandei* Em, det. W. L. Brown", in MCZC. Paratypes: 3 workers labelled as the holotype, 2 paratype workers in LACM, 1 paratype worker in MCZC.

DERIVATIO NOMINIS: this species is named after the Chickasaw, an Indian tribe from Tennessee.

DIAGNOSIS. A *Proceratium* species belonging to the *pergandei* clade and differing from its sister species, *pergandei*, by the postpetiole superficially granulate instead of densely granulate, by the longer gaster (IGR 0.24-0.26 instead of 0.26-0.31), and by the gaster with sparser and longer hairs.

DESCRIPTION. *Worker* (Figs. 98 & 99). Head longer than broad, its sides subparallel in the two anterior thirds and gently converging in the posterior third. Anteromedian part of the clypeus rectangular and strongly protruding anteriorly, dorsally with a variably marked inverted Y-shaped carina. Frontal carinae diverging posteriorly, slightly raised and not very close each other. Lateral expansions of the frontal carinae narrow. Genal carina absent. Gular area not impressed. Eyes small, composed by a minute, flat dark dot below the integument. Eyes placed on the mid line of the head. First funicular joint about 1/5 longer than broad. Funicular joints 2-10 almost as broad as long or slightly broader than long. Last funicular joint about as long as the sum of joints 8-10. Scapes much short of the vertexal margin and gently thickening apically. Antennal torulus placed behind the lateral border of the

clypeus. Masticatory margin of the mandibles with 4-5 denticles before the pointed apical tooth. Palp formula 4,3.

Mesosoma as long as or slightly shorter than maximum head length (mandibles included). Promesopleural and meso-metapleural sutures impressed ventrally only. Basal and declivous faces of the propodeum separated by a carina sometimes interrupted medially. Declivous face of the propodeum with a relatively broad semitransparent lamella sometimes denticulate on each side between the basal and declivous faces. Propodeal spiracle round and placed above mid height in lateral view.

Petiole convex in profile, with the sides diverging on the anterior fourth and strongly convex posteriorly in dorsal view. Anterior border of the petiole gently concave and not carinate. Ventral process of the petiole lamelliform, triangular and pointed. Postpetiole anteriorly as broad as or only

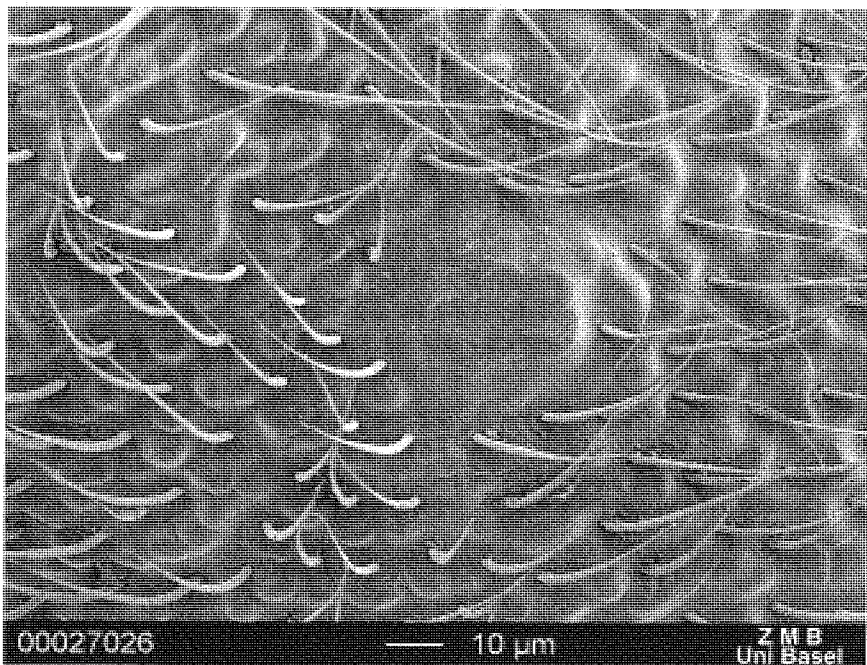


Fig. 98 – *Proceratium chickasaw* de Andrade. Worker from Appalachian Bluffs & Ravines Preserve, Liberty Co., Florida: left eye.

slightly broader than the petiole; its sides diverging, sometimes gently convex posteriorly. Postpetiolar sternite anteromedially with a marked subtriangular projection. Posterior half of the postpetiolar sternite convex. Constriction between postpetiole and first gastral segment impressed. Gastral tergite I strongly projecting on the curvature. Remaining gastral tergites and sternites curved ventrally and placed on the anterior half of the first gastral tergite.

Legs slender but not very elongate. All tibiae with a pectinate spur. Spurs of fore legs with basal spine. Fore basitarsi longer than the mid ones. Hind basitarsi about 1/5 shorter than hind tibiae. Second tarsomere of hind leg longer than the pretarsus. Pretarsal claws simple. Pretarsal arolia absent.

Sculpture. Body minutely granulopunctate, the granulation less marked and sparse on the postpetiole and on the legs, absent from the gaster. Gaster shining and with minute piligerous impressions.

Pilosity similar to the one of *pergandei* but differing in the following: hair type (1) sparser on the gaster and hairs types (1 and 2) longer on the gaster.

Colour light brown.

Measurements in mm and Indices: TL 3.79-4.41; HL 0.82-0.94; HW 0.71-0.82; EL 0.04-0.05; SL 0.54-0.64; WL 1.00-1.16; PeL 0.32-0.35; PeW 0.32-0.36; HFeL 0.64-0.75; HTiL 0.55-0.66; HBaL 0.43-0.52; LS4 0.25-0.30; LT4 1.00-1.25; CI 85.2-87.2; SI 65.8-71.6; IGR 0.24-0.26.

MATERIAL EXAMINED: UNITED STATES: TENNESSEE: Oltawah, 3.VI.1947, 4 workers, Pfizer [LACM]; Montgomery Bell Park, Dickson Co., 17-19.VI.1948, 1 worker, Pfizer & Scott [LACM]; Chilhowee Mts., Sevier Co., 16.IV.1954, 1 worker, A. Cole [LACM]; Farmer, Polk Co., 25.V.1951, 4 workers (holotype and paratypes), E. O. Wilson [LACM, MCZC]; Nashville, 1 worker, L. Wesson [MCZC]; McMinn Co., Highway 39, 8.6 km W junction 315, 12.VI.1998, 1 worker, Mackay et al. [WEMC]. ALABAMA: Alabama Port, Mobile Co., 28.IV.1949, 1 worker, E. O. Wilson [MCZC]; Elrod, Tuscaloosa Co., 10.V.1949, 1 worker, E. O. Wilson [MCZC]. MISSISSIPPI: Ripley, 28.VI.1930, 1 worker, S. Simmons [LACM]. GEORGIA: Decatur Co., International Paper Southland Experimental Forest, (near Faceville) 0.7 mile W jct main rd and rt. 97, 1.VI.2000, Berlese leaf litter from Beech-Magnolia ravine, 5 workers, P. Kovarik & C. O'Brien

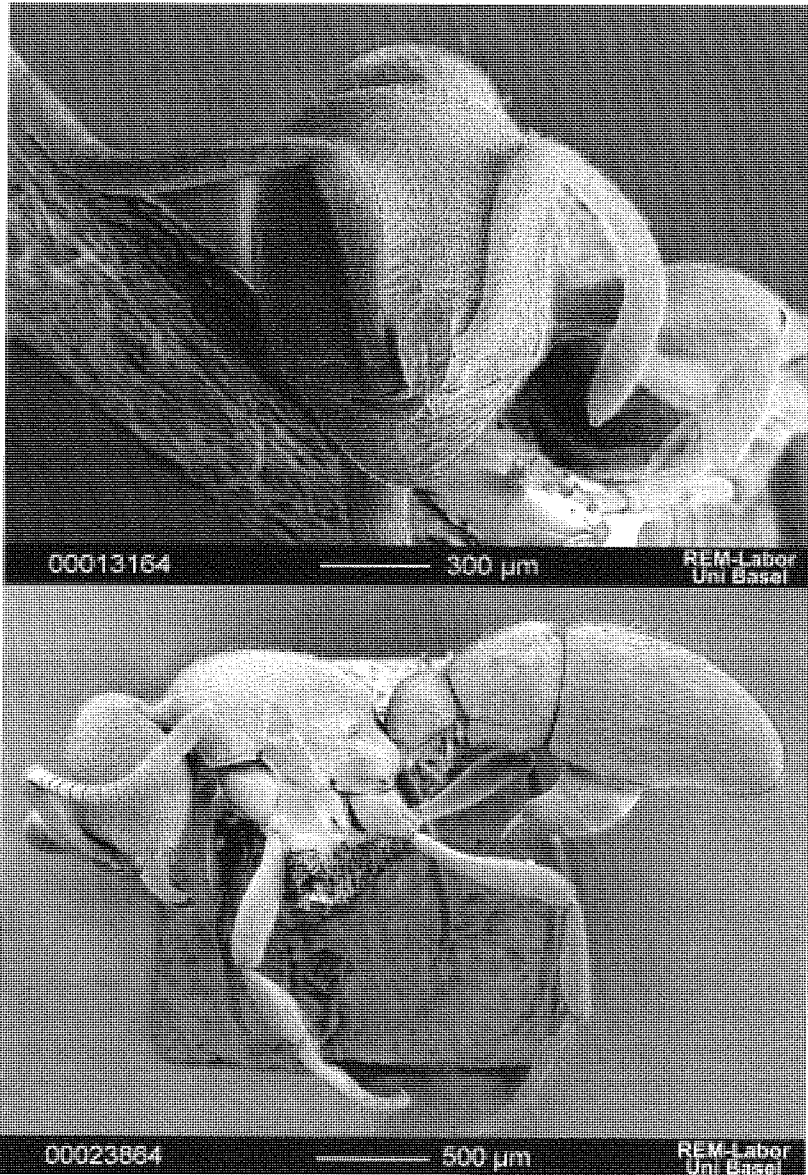


Fig. 99 – *Proceratium chickasaw* de Andrade. Worker from USA: head (top) in dorsal view from Oltawah, Tennessee and meso- and metasoma (bottom) in side view from Appalachicola Bluffs & Ravines Preserve, Liberty Co, Florida.

[MCZC, MRSN]. FLORIDA: Liberty Co., Appalachicola Bluffs & Ravines Preserve, 11.V.2000, 1 worker, sifted litter in shade, S. P. Cover [MCZC]; Liberty Co., Torreya State Park, 12.V.2000, sifted litter in shade, 1 worker, S. P. Cover [MCZC]; Liberty Co., Bristol, 11.V.2000, Bluffs & Ravines Preserve, 1 worker, M. Deyrup & S. P. Cover [ABSC]; Liberty Co., Bristol, Torreya State Park, 12.V.2000, 1 worker, in ravine habitat, M. Deyrup & S. P. Cover [ABSC].

DISCUSSION. *P. chickasaw* is extremely similar to *pergandei* with which it was previously confused. The two species are sympatric since they have been collected at least once in the same locality of Tennessee (Chilhowee Mt., Sevier Co., at two different dates, see material examined). WESSON & WESSON (1940) report two workers from 45 miles of Jackson (Ohio) differing from other collections and from Emery's drawing of *pergandei* by the head as broad as long, by the first gastral segment shining above and by the second gastral segment compressed dorsoventrally and elongate. We did not see this material but it is likely that it represents the new species described as *chickasaw* in this paper. We examined a single worker from Nashville (Tennessee) collected by L. Wesson (MCZC) and it belongs to *chickasaw*.

DISTRIBUTION: United States (Tennessee, Alabama, Mississippi and Florida).

### ***Proceratium melitense* de Andrade n. sp.**

Fig. 100

TYPE MATERIAL: holotype worker from Buskett, Malta, labelled: "Malta, Buskett, 11.I.1996, leg. D. Mifsud, in soil, *Quercus ilex* soil", in MMCR; paratypes: 2 workers labelled: "Il Ballut (limits of Wardija), San Pawl il-Bahar, 1.IV.2002, D. Mifsud, shifting leaf litter under *Quercus ilex*", in DMCM.

DERIVATIO NOMINIS: from the Latin *melitensis* (Lucretius) = Maltese. This name, however, proved inaccurate when, at a later stage of our work, we received a Sicilian specimen of this species.

DIAGNOSIS. A *Proceratium* species belonging to the *pergandei* clade and differing from its outgroup species, *californicum*, in the worker by the propodeal suture absent instead of marked; by the antennae and legs with erect-suberect hairs superimposed to the appressed ones instead of appressed hairs superimposed to rare, subdecumbent hairs on the antennae only; and from the ingroup species, *pergandei* and *chickasaw*, in the worker, by the lack of propodeal lamellae and by the gaster posteriorly round instead of angulate.

DESCRIPTION. *Worker* (Fig. 100). Head longer than broad, with sides weakly convex in the middle and gently converging posteriorly. Vertex in full face view gently convex. Anteromedian part of the clypeus rectangular and strongly protruding anteriorly, dorsally with a very superficially marked bifurcated carina. Frontal carinae gently diverging posteriorly. Lateral expansions of the frontal carinae broad and raised. Head anterolaterally with a short, superficially marked longitudinal carina. Genal carina absent. Gular area not impressed. Eyes absent, recognizable as few minute dots at the mid line of the head. First funicular joint  $1/3$  longer than broad. Funicular joints 2-10 about as broad as long. Last funicular joint as long as the sum of the joints 8-10. Antennal torulus behind the lateral border of the clypeus. Scapes slightly short of the vertexal margin and thickening apically. Masticatory margin of the mandibles with 4-5 denticles before a pointed apical tooth. Palp formula 4,3.

Mesosoma slightly longer than the head (mandibles included). Pronotum and mesonotum convex in profile. Propodeal suture absent. Basal face of the propodeum slightly declivous posteriorly. Area between basal and declivous faces of the propodeum weakly concave. Propodeal concavity dorsally superficially marginate and subangulate on the sides. Declivous face of the propodeum marginate. Propodeal lobes round and lamellaceous. Petiole convex in profile. Its sides diverging on the anterior fourth and convex posteriorly in dorsal view. Anterior border of the petiole weakly concave and laterally carinate. Ventral process of the petiole lamelliform and triangular. Postpetiole slightly longer than  $1/2$  of the gastral tergite I; its anterior face high and broader than the petiole; its sides convex. Postpetiolar sternite anteromedially with a marked subtriangular projection. Constriction between postpetiole and first gastral segment impressed. Gaster tergite I



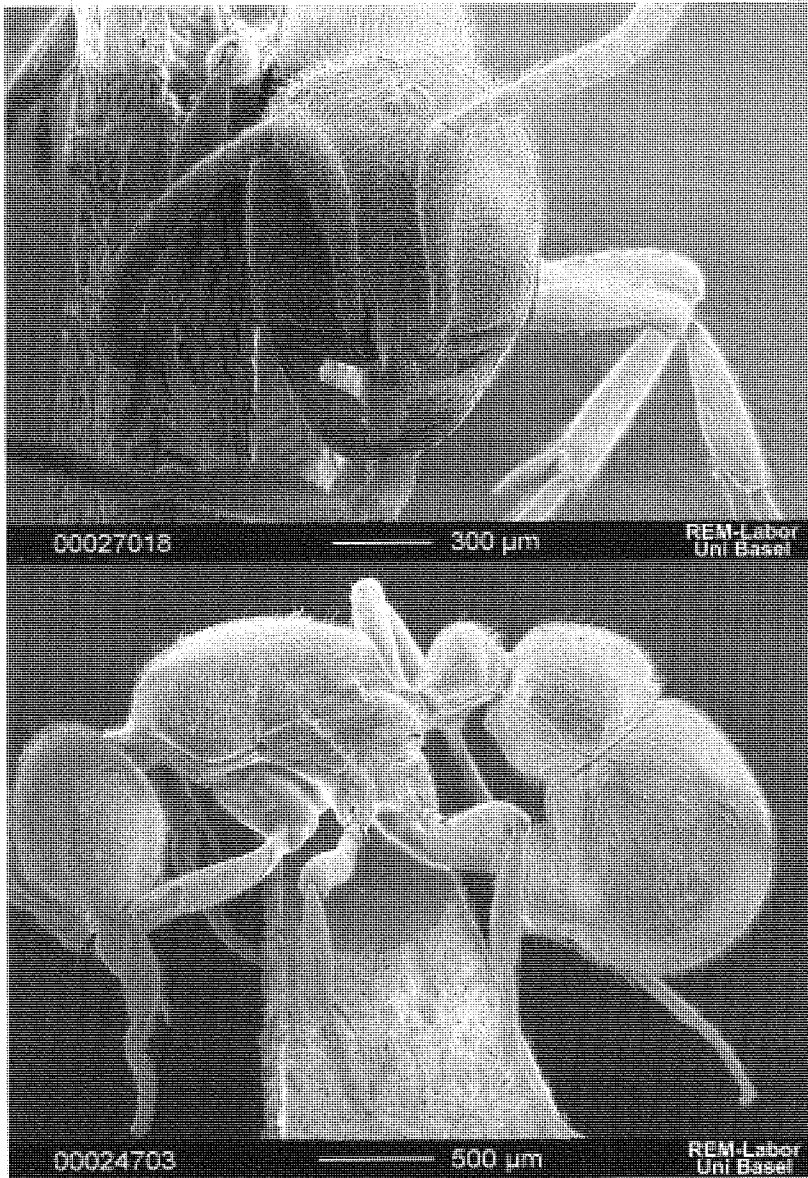


Fig. 100 – *Proceratium melitense* de Andrade. Worker (holotype) from Buskett, Malta: head (top) in dorsal view and meso- and metasoma (bottom) in side view.

convex on the curvature. Remaining gastral tergites and sternites originating just after the curvature.

Legs slender. All tibiae with a pectinate spur. Spurs of fore legs with basal spine. Fore basitarsi as long as the mid ones. Hind basitarsi about 1/7 shorter than hind tibiae. Second tarsomere of hind legs longer than the pretarsus. Pretarsal claws simple. Arolia present but small.

Sculpture. Head, mesosoma and petiole punctate, the punctures more superficial and sparser on the antero-dorsal part of the mesosoma. Propodeal dorsum and petiole with additional, few, small granulations. Postpetiole and gaster with minute piligerous punctures, smaller on the gaster. Legs finely punctate.

Body covered by hairs of three main types: (1) short, dense, subdecumbent on the whole body, sparse and suberect on the funicular joints; (2) longer than type (1), sparse, erect and suberect on the whole body, absent on the funiculi; (3) shorter than hair type (1), dense and decumbent on the funicular joints only. In addition the funicular joints bear whitish, thick, appressed, short, sparse hairs, and the scapes with sparse hairs similar to type (2) but shorter.

Colour light brown.

Measurements in mm and Indices: TL 4.23-4.40; HL 0.97; HW 0.82-0.85; SL 0.71; WL 1.18-1.24; PeL 0.36-0.37; PeW 0.35-0.37; HFeL 0.84-0.85; HTiL 0.70; HBaL 0.59-0.60; LS4 0.34-0.39; LT4 0.99-1.10; CI 84.5-87.6; SI 72.2-73.2; IGR 0.34-0.35.

MATERIAL EXAMINED: MALTA: Buskett, 11.I.1996, in soil, *Quercus ilex* soil, 1 worker (holotype), D. Mifsud [MMCR]; Imtahleb, 13.I.1999, 1 worker, D. Mifsud [DMCM]; Il Ballut (limits of Wardija), San Pawl il-Bahar, 1.IV.2002, shifting leaf litter under *Quercus ilex*", 2 workers (paratypes) D. Mifsud [DMCM]. ITALY: SICILY: Messina, 1 worker, F. Vitale [MSNM].

DISCUSSION. *P. melitense*, as was to be expected, exhibits the greatest similarity with its geographically closest species, *algericum*. Phylogenetically it appears nonetheless close also to two nearctic species, *chickasaw* and *pergandei* for sharing synapomorphically with them (and with other species as well) the rectangular clypeus. The absence of propodeal lamellae,

a character shared with all the basic species of the clade differentiates it from *algiricum* and from the remaining species.

We received the Sicilian specimen reported above at a late stage of advancement of our revision. This explains the incorrect name we gave to this species and poses some additional problems. This Sicilian specimen, in fact, comes from the same locality from which *P. algiricum* was reported by Emery (1909). Since during the present revision we were able to study also a Sicilian specimen of true *algiricum*, coexistence in narrow sympatry of *algiricum* and *melitense* is plausible. One cannot exclude, however, that some of the former records of *P. algiricum* (or of its junior synonym *mayri*) from South Italy should be referred to *melitense*.

DISTRIBUTION: Malta and Sicily.

### ***Proceratium californicum* Cook**

Figs. 101, 102

*Proceratium* (sic) *californicum* Cook, 1953: 45, not numbered fig. Male. Original description. Type locality: Glenwood, California, USA.

*Proceratium californicum* Cook, Brown, 1958a: 332.

*Proceratium californicum* Cook, Snelling, 1967: 2, fig. 1 (male and gyne). Male and gyne.

*Proceratium californicum* Cook, Ward, 1988: 109, figs. 3-5. Worker.

TYPE MATERIAL: a male in LACM (Snelling, 1969) not available for the present study.

DIAGNOSIS. A *Proceratium* species belonging to the *pergandei* clade and differing from its ingroup species, *melitense*, in the worker by the presence of a marked propodeal suture (no visible suture in *melitense*) and by the antennae and legs without erect-suberect hairs, and from its outgroup species *confinium*, in the worker, by the antennal socket behind the anterolateral clypeal border (strongly surpassing the anterolateral clypeal border in *confinium*) and by the sculpture on the head, mesosoma and petiole more superficial.

DESCRIPTION. *Worker* (Fig. 101). Head longer than broad, its sides weakly convex in the middle, gently converging posteriorly. Vertexal mar-

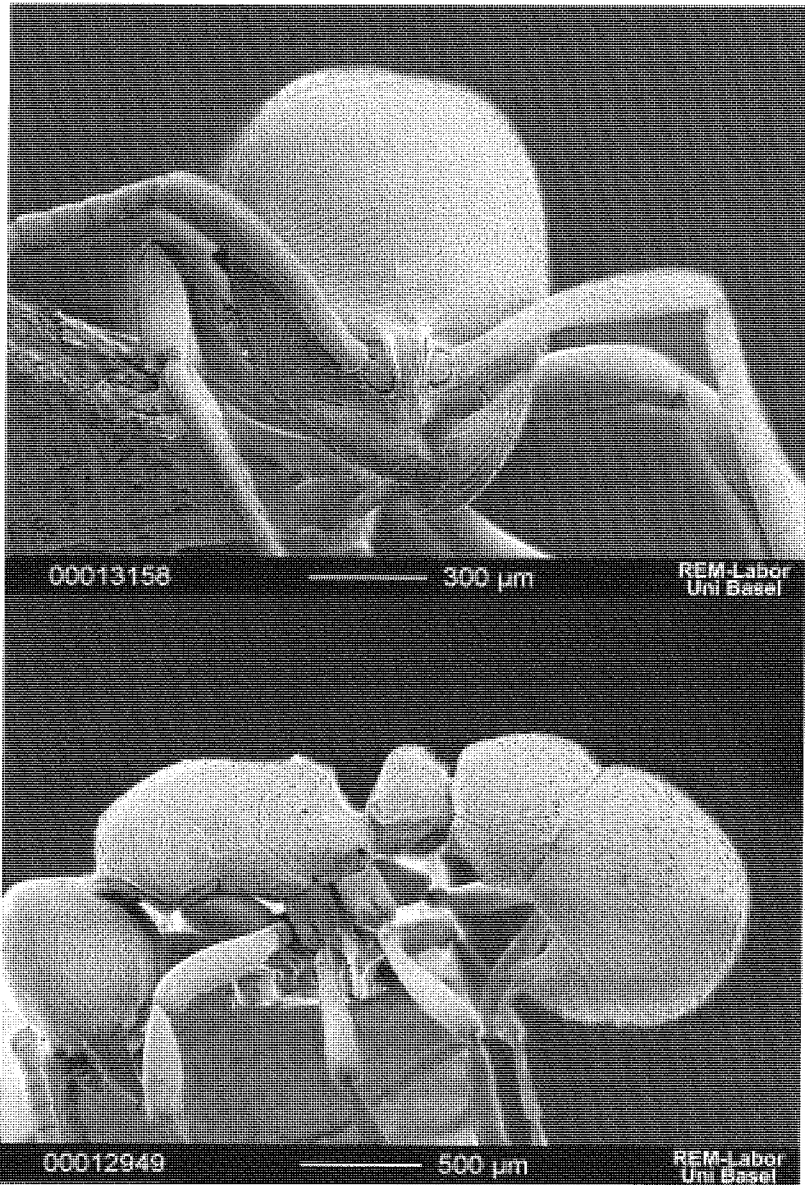


Fig. 101 – *Proceratium californicum* Cook. Worker from 4 km E Yolo, California, USA: head (top) in dorsal view and meso- and metasoma (bottom) in side view.

gin nearly flat medially. Anteromedian part of the clypeus triangular and protruding anteriorly, dorsally with a superficially marked, bifurcated carina. Frontal carinae gently diverging posteriorly. Lateral expansions of the frontal carinae not very far from each other, higher and broader posteriorly. Head anterolaterally with a short, superficially marked longitudinal carina. Genal carina absent. Gular area not impressed. Eyes absent, represented by a few minute dots at the mid line of the head sides. First funicular joint 1/3 longer than broad. Funicular joints 2-10 about as broad as long. Last funicular joint as long as the sum of the joints 8-10. Scapes slightly short of the vertexal margin and gently thickening apically. Antennal torulus behind the lateral border of the clypeus. Masticatory margin of the mandibles with 4-5 denticles before the pointed apical tooth. Palp formula 4,3.

Mesosoma about as long as the head (mandibles included). Pronotum and mesonotum convex in profile. Propodeal suture impressed. Basal face of the propodeum slightly declivous posteriorly. Area between basal and declivous faces of the propodeum concave. Propodeal concavity dorsally carinate and laterally denticulate. Sometimes the propodeal carina incomplete medially and a small peak may be present. Declivous face of the propodeum marginate. Propodeal lobes subround and marginate only. Propodeal spiracle round and above mid height in lateral view.

Petiole in side view convex. Petiole in dorsal view with the sides anteriorly shortly diverging and strongly convex posteriorly. Anterior border of the petiole gently concave and carinate, the carina denticulate on each side. Posterior half of the petiolar dorsum with a median, longitudinal carina. Ventral process of the petiole lamelliform and short. Postpetiole robust; its anterior face high and broader than the petiole; its sides gently convex. Postpetiolar sternite, anteromedially, with a marked subtriangular projection. Posterior half of the postpetiolar sternite convex. Constriction between postpetiole and first gastral segment impressed. Gastral tergite I strongly convex on the curvature. Remaining gastral tergites and sternites originating just after the curvature.

Legs slender. All tibiae with a pectinate spur. Spurs of fore legs with basal spine. Fore basitarsi as long as the mid ones. Hind basitarsi about 1/5 shorter than hind tibiae. Second tarsomere of hind leg longer than the pretarsus. Pretarsal claws simple. Arolia present.

Sculpture. Head, mesosoma, petiole and legs finely reticulate-punctate, this sculpture more superficial on the legs. Postpetiole and gaster superficially shining and covered by minute piligerous impressions.

Body covered by hairs of three main types: (1) short, dense, appressed on the whole body; (2) slightly longer than hair type (1), subdecumbent and decumbent on the whole body, sparser on the mesosoma, rare on the antennae and absent from the legs; (3) shorter than hair type (1), dense and appressed on the funicular joints only. In addition the funicular joints bear whitish, thick, appressed, short, sparse hairs.

Colour light brown.

Measurements in mm and Indices: TL 3.82-3.96; HL 0.90-0.94; HW 0.80-0.84; EL 0.04-0.05; SL 0.68-0.70; WL 1.08-1.10; PeL 0.33; PeW 0.33-0.34; HFeL 0.76-0.80; HTiL 0.68-0.70; HBaL 0.54-0.56; LS4 0.34-0.36; LT4 0.90-0.93; CI 89.0-89.4; SI 74.5-75.6; IGR 0.38-0.39.

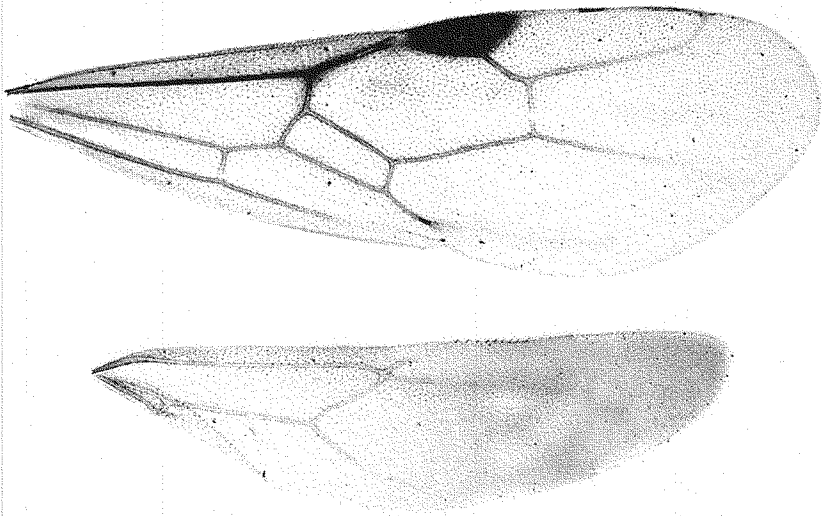


Fig. 102 – *Proceratium californicum* Cook. Gyne from Santa Monica, California, USA: fore and hind wings.

*Gyne*. Differing from the worker in the following details: eyes about 1/5 of the head length and with well defined ommatidia. Ocular pilosity present. Ocelli present. Mandibles with 6-7 denticles before the apical tooth.

Mesosoma robust. Scutellum as long as the length of the sides of the basal face of the propodeum; its sides gently converging into a convex posterior border. Metanotum with a denticle. Declivous face of the propodeum without a peak on the center of the concavity. Each side of the propodeal concavity with a subround tooth of variable size.

Petiolar node in side view narrower and higher. Ventral process of the petiole slightly more developed and subtriangular.

Fore wings of our type 2, hind wings of our type 2 as defined in the description of the genus (Fig. 102).

Pilosity and colour as in the worker.

Measurements in mm and Indices: TL 4.88-5.18; HL 0.96-1.04; HW 0.90-0.96; EL 0.19-0.20; SL 0.72-0.82; WL 1.36-1.44; PeL 0.39; PeW 0.40-0.44; HFeL 0.92-0.98; HTiL 0.81-0.84; HBaL 0.67-0.72; LS4 0.52; LT4 1.30-1.40; CI 92.3-94.0; SI 75.0-79.0; IGR 0.37-0.40.

*Male*. Not available for the present study. The redescription of the holotype and the drawings by Snelling (1967) should be largely sufficient to differentiate it from closely related species.

MATERIAL EXAMINED: UNITED STATES: CALIFORNIA: Valle Vista, Oakland, Alameda Co., 21.IV.1928, 1 gyne [MCZC]; Carmel, 8.IV.1928, 2 gynes, L. S. Slevin [CASC]; Santa Monica Mts., Los Angeles, 19.IV.1957, 2 gynes, Bimantoro [LACM]; 4 km E Yolo, Yolo Co., 15 m, 23.II.1985, 1 worker, sifted litter (leaf mould, rotten wood), riparian woodland, P. S. Ward [LACM]; Marin Co., Ring Mountain, Tiburon Penin., 29.IV.1994, serpentine grassland, 1 worker, D. Ubick & J. Boutin [CASC].

DISCUSSION. *P. californicum* is very distinct from all the other species of the *pergandei* clade for its body pilosity consisting mainly by dense, short, appressed hairs and also sparse, slightly longer hairs which are subdecumbent and decumbent but rare on the antennae and lacking on the legs.

DISTRIBUTION: United States (California).

**Proceratium confinium** de Andrade n. sp.

Fig. 103

TYPE MATERIAL: holotype worker from Malkandi, Pakistan labelled: "Pakist. Swat, Malkandi 36, 1500 m, 2.VI.83, Löbl-Besuchet", in MHNG.

DERIVATIO NOMINIS: from the Latin *confines*, referred to its provenance from the Frontier Territories.

DIAGNOSIS. A *Proceratium* species belonging to the *pergandei* clade and differing from its ingroup species, *californicum*, in the worker, by the antennal socket strongly surpassing the anterolateral clypeal border instead of simply behind the anterolateral clypeal border, by the sculpture on the head, mesosoma and petiole more marked and by the presence of long, suberect hairs on the antennae, head, mesosoma, petiole, postpetiole and legs.

DESCRIPTION. *Worker* (Fig. 103). Head longer than broad, with subparallel sides, gently converging posteriorly on the posterior fourth. Vertex in full face view flat. Anteromedian part of the clypeus small, triangular, protruding anteriorly slightly more than the antennal socket. Antennal socket strongly protruding anteriorly and surpassing the anterolateral clypeal margin. Frontal carinae almost touching each other, narrowly separated posteriorly. Lateral expansions of the frontal carinae extremely narrow and slightly higher medially. Head anterolaterally with a short, superficially marked, longitudinal carina. Genal carina absent. Gular area not impressed. Eyes absent: without trace even of pigmented cuticular spot. First funicular joint about half longer than broad. Funicular joints 2-10 as broad as long to slightly longer than broad. Last funicular joint slightly shorter than the sum of the joints 7-10. Scapes almost reaching the vertexal border. Masticatory margin of the mandibles with 3 denticles before the pointed apical tooth. Palp formula apparently 3,2.

Mesosoma robust, longer than the head length (mandibles included). Pronotum and mesonotum convex in profile. Propodeal suture deeply impressed. Basal face of the propodeum slightly declivous posteriorly. The area between the basal and declivous faces gently concave and minutely denticulate on each side. Declivous face flat; its sides marginate. Propodeal spiracle round and above mid height in lateral view. Propodeal lobes round and with a lamellaceous border.



Petiole convex in side view and with the sides diverging on the anterior fourth and strongly convex posteriorly in dorsal view. Anterior border of the petiole concave and carinate, the carina denticulate on each side. Ventral process of the petiole lamelliform, broad and triangular. Postpetiole half long as gastral tergite I; its anterior face high and broader than the petiole; its sides gently convex. Postpetiolar sternite anteromedially with a broadly marked subtriangular projection protruding anteriorly. Posterior half of the postpetiolar sternite flat. Constriction between postpetiole and first gastral segment impressed. Gaster strongly convex on the curvature. Remaining gastral tergites and sternites originating just after the curvature.

Legs slender but not very elongate. All tibiae with a pectinate spur. Spurs of fore legs with basal spine. Fore basitarsi as long as the mid ones. Hind basitarsi about 1/6 shorter than hind tibiae. Second tarsomere of hind leg longer than the pretarsus. Pretarsal claws simple. Arolia present.

Sculpture. Head granulopunctate. Mesosoma and petiole granulate. Postpetiole superficially shining, very sparsely granulate. Legs minutely punctate. Gaster superficially shining and covered by minute, piligerous impressions.

Body covered by hairs of three main types: (1) short, dense, decumbent or appressed on the whole body, sparse and suberect on the funicular joints; (2) longer than type (1) suberect on the whole body, absent on the funiculi; (3) shorter than hair type (1), dense and appressed on the funicular joints only. In addition the funicular joints bear whitish, thick, appressed, short, sparse hairs, and the scapes with sparse hairs shorter than hair type (2).

Colour light brown.

Measurements in mm and Indices: TL 3.29; HL 0.79; HW 0.63; SL 0.66; WL 0.95; PeL 0.30; PeW 0.26; HFeL 0.67; HTiL 0.63; HBaL 0.52; LS4 0.30; LT4 0.80; CI 79.7; SI 83.5; IGR 0.37.

MATERIAL EXAMINED: PAKISTAN: Malkandi S of Kagan (Hazara region), 1500 m, 2.VI.1983, forest soil sieving 36, 1 worker (holotype), Löbl & Besuchet [MHNG].

DISCUSSION. *P. confinium* resembles *californicum* in general morphology. Both species have impressed propodeal suture, a unique character for some members of the *pergandei* clade but appearing also in two other

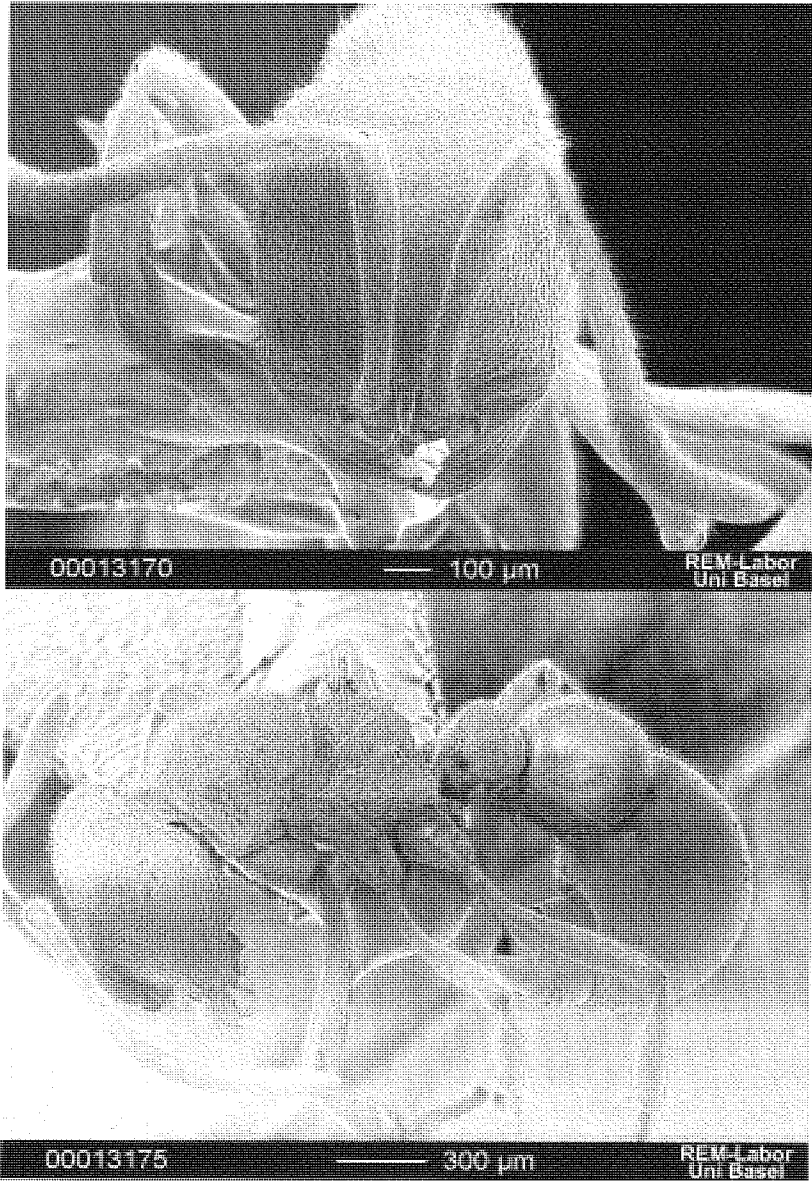


Fig. 103 – *Proceratium confinium* de Andrade. Worker (holotype) from Malkandi, Swat, Pakistan: head (top) in dorsal view and meso- and metasoma (bottom) in side view.

species (*toschii* and *microsculptum*) belonging to different clades. Examination of the sole known *confinium* specimen without dissecting it suggests that it may differ from all other species of the *pergandei* clade by the palp formula 3,2 instead 4,3. Since certainty about this character state can be reached only after dissection, we preferred the conservative attitude of coding this character as unknown in our data matrix.

DISTRIBUTION: Pakistan.

### **Proceratium melinum (Roger)**

Figs. 104, 105, 106, 107

*Ponera melina* Roger, 1860: 291. Worker, gyne and male. Original description. Type locality: Carolina (probably a labelling error, see Brown, 1958a). Type material: a worker and a gyne (syntypes) labelled: "Carolina, *Proceratium melinum* Rog., Type, *melina* Roger, Zool. Mus. Berlin" in ZMBC, examined.

*Proceratium melinum* (Roger), Mayr, 1886: 438 First combination in *Proceratium*.

*Sysphincta* (sic) *europaea* Forel, 1886: clxiii, fig. 2. Worker. Type locality: Greece. Type material: holotype worker labelled: "Albanien, Avlona, v. Oertzen., 88, *Sysphincta*, *P. europaeum*, Forel, Typus" in MHNG, examined. Synonymy with *melinum* by Brown, 1958a: 248.

*Proceratium europaeum* Forel, 1888: 258. First combination in *Proceratium*.

*Proceratium europaeum* Forel, 1888: 259. Gyne.

*Sysphincta melina* (Roger), Emery, 1895: 263, figs 1-3. Worker, gyne and male. First combination in *Sysphincta*.

*Proceratium europaeum* Forel, 1905: 177. Male.

*Sysphincta europaea* Forel, Emery, 1909: 359, fig. 2 b & 3.

*Sysphincta europaea* Forel, Emery, 1916: 103, figs. 12b (worker), 12c (male).

*Sysphincta europaea* Forel, Lomnicki, 1922: 1.

*Sysphincta europaea* Forel, Menozzi, 1925: 24.

*Sysphincta europaea rossica* Arnoldi, 1930: 144, figs. 1-3. Worker and gyne. Type locality: Don steppe, Russia. Type material: not available for the present study. Synonymy with *melinum* by Brown, 1958a: 248.

*Sysphincta europaea rossica* Arnoldi, Arnoldi, 1932: 50.

*Sysphincta fialai* Kratochvíl, 1944: 54, figs. 1-4. Worker, gyne and male. Type locality:

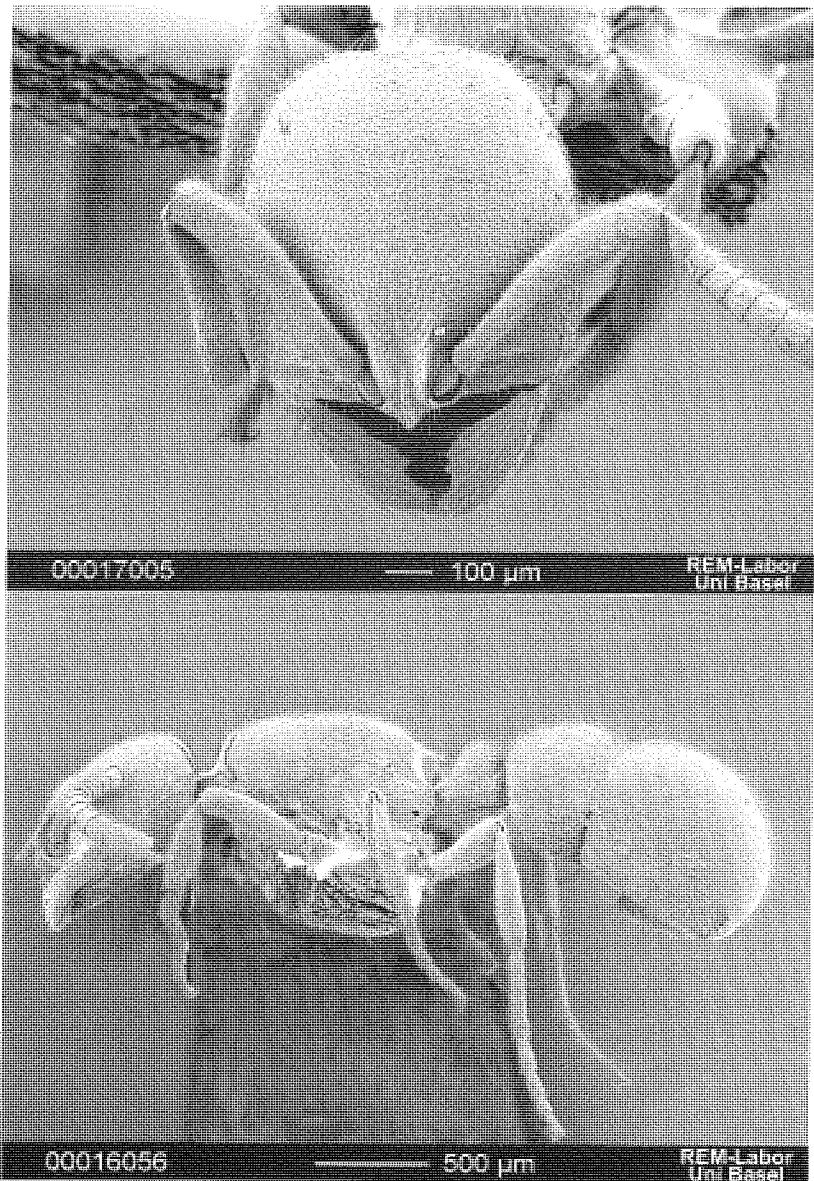


Fig. 104 – *Proceratium melinum* (Roger). Worker from Castelvetro, Emilia, Italy: head (top) in dorsal view and meso- and metasoma (bottom) in side view.

Mohelno Reserve, Czech Republic. Type material: not available for the present study. Synonymy with *melinum* by Brown, 1958a: 248.

*Proceratium melinum* (Roger), Brown, 1958a: 248.

**DIAGNOSIS.** A *Proceratium* species belonging to the *pergandei* clade and differing from its ingroup species, *confinium*, in the worker, mainly by the frontal carinae separate instead of very close to each other, by the antennal scapes shorter and by the fore basitarsi longer than the mid basitarsi instead of subequal; and from its outgroup, *morisitai*, in the worker and gyne, by the head rugosopunctate instead of granulate and by the second tarsomere of hind leg about 1/5 longer than the pretarsus instead of about as long as the pretarsus, and, in the male, by the IGR = 0.62 instead of IGR 0.68.

**DESCRIPTION.** *Worker* (Fig. 104). Head longer than broad, its sides gently convex in the two anterior thirds and weakly converging in the posterior third. Anteromedian part of the clypeus narrow, triangular and protruding anteriorly, with a variably marked longitudinal carina dorsally. Frontal carinae diverging posteriorly, poorly raised and not close to each other. Lateral expansions of the frontal carinae narrow. Genal carina absent. Gular area not impressed. Eyes small and represented by a dark dot below the integument. Eyes on the midline of the head. First funicular joint slightly longer than broad. Funicular joints 2-10 about as broad as long or slightly broader than long. Last funicular joint about as long as the sum of joints 7-10. Scapes much shorter than the vertexal margin and gently thickening apically. Masticatory margin of the mandibles with 4-5 denticles before the pointed apical tooth. Palp formula 4,3.

Mesosoma as long as or slightly shorter than maximum head length (mandibles included). Propodeal suture dorsally poorly impressed in some specimens. Basal face of the propodeum gently declivous posteriorly. Area between basal and declivous faces of the propodeum superficially concave and separated laterally by a small denticle. Declivous face of the propodeum flat and with superficially marginate sides. Propodeal lobes subround. Propodeal spiracle round and above the mid height in lateral view.

Petiole about as long as broad, convex in side view and with the sides diverging on the anterior fourth and convex posteriorly in dorsal view. Anteri-

or border of the petiole concave and carinate, the carina forming a denticle on each side. Ventral process of the petiole lamelliform, truncate anteriorly and pointed posteriorly. Postpetiole anteriorly broader than the petiole; its sides diverging or gently convex. Postpetiolar sternite anteromedially with a marked subtriangular projection. Posterior half of the postpetiolar sternite strongly convex. Constriction between postpetiole and first gastral segment impressed. Gastral tergite I strongly convex on the curvature. Remaining gastral tergites and sternites curved ventrally.

Legs slender but not very elongate. All tibiae with a pectinate spur. Spurs of fore legs with basal spine. Fore basitarsi longer than the mid ones. Hind basitarsi about 1/5 shorter than hind tibiae. Second tarsomere of hind leg about 1/5 longer than the pretarsus. Pretarsal claws simple. Arolia large.

Sculpture. Head rugosopunctate. Mesosoma granulpunctate. Petiole and postpetiole granulate. Gaster superficially shining and covered by piligerous impressions. Legs punctate.

Pilosity. Body covered by hairs of three main types: (1) short, dense, subdecumbent on the whole body, sparse and suberect on the funicular joints, absent on the funiculi; (2) longer than type (1), sparse and suberect on the whole body; (3) shorter than hair type (1), dense and decumbent on the funicular joints only. In addition the funicular joints bear whitish, thick, appressed, short, sparse hairs, and the scapes with sparse hairs shorter than hair type (2).

Colour yellowish to light brown.

Measurements in mm and Indices: TL 3.30-4.15; HL 0.76-0.91; HW 0.69-0.82; EL 0.03-0.05; SL 0.53-0.69; WL 0.93-1.15; PeL 0.28-0.37; PeW 0.29-0.35; HFeL 0.58-0.73; HTiL 0.51-0.67; HBaL 0.40-0.56; LS4 0.30-0.45; LT4 0.68-1.01; CI 88.6-91.0; SI 69.2-74.4; IGR 0.42-0.44.

*Gyne*. Differing from the worker in the following details: eyes large, about 1/4 of the head length and with well defined ommatidia. Ocular pilosity present. Ocelli developed. Mesosoma robust. Scutellum large, slightly longer than the length of the basal face of the propodeum; its sides gently converging into a convex posterior border. Metanotum with or without traces of a minute denticle. Spiniform ventral process of the petiole longer.

Fore wings of our type 2, hind wings of our type 1 as defined in the description of the genus (Fig. 105).

Measurements in mm and Indices: TL 4.37-4.64; HL 0.87-0.90; HW 0.79-0.83; EL 0.21-0.22; SL 0.61-0.64; WL 1.24-1.30; PeL 0.37-0.38; PeW 0.36-0.38; HFeL 0.78; HTiL 0.67; HBaL 0.52-0.53; LS4 0.45-0.50; LT4 1.08-1.16; CI 91.0-92.2; SI 70.1-71.1; IGR 0.42-0.43.

*Male.* Head slightly broader than long. Vertex in full face view convex. Vertexal margin carinate. Clypeus subround or triangular; its dorso-median part with a superficial longitudinal carina. Frontal carinae thin, low, parallel or slightly diverging posteriorly. Frontal area with a sulcus. Ocelli large. Compound eyes large and placed mostly on the anterior part of the head sides. Scapes reaching the vertexal margin. First funicular joint about 1/4 longer than broad, thicker and about 1/4 shorter than second joint. Joints 2-11 longer than broad. Last funicular joint as long as the sum of joints 10-11. Mandibles with a minute, median denticle before a pointed apical tooth. Palp formula 4,3.

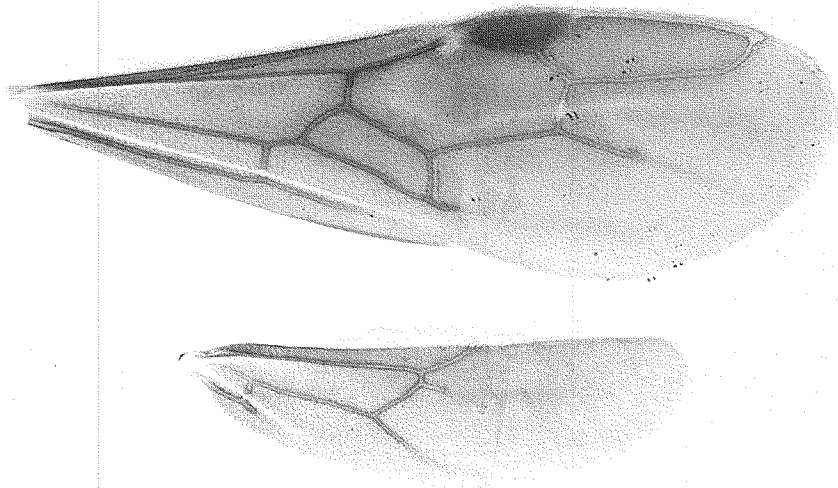


Fig. 105 – *Proceratium melinum* (Roger). Gyne from Castelvetro, Emilia, Italy: fore and hind wings.

Mesosoma robust. Pronotum and anterior third of mesonotum almost perpendicular to the posterior two thirds of the mesonotum. Posterior two thirds of mesonotum almost flat. Parapsidal furrows marked. Scutellum about as high as the mesonotum; posterior border of scutellum round. Basal face of the propodeum declivous posteriorly. Sides of the basal face of the propodeum gently converging posteriorly. Sides between basal and declivous face of the propodeum subangulate. Declivous face of propodeum flat. Metanotum with a median, minute, carinate denticle. Propodeal lobes round. Propodeal spiracles small.

Petiole about as long as broad, declivous in the anterior third and convex in the two posterior thirds in profile. Sides of the petiole in dorsal view subparallel in the anterior third and convex posteriorly. Anterior border of the petiole concave, carinate and laterally angulate. Subpetiolar process as in the worker. Postpetiole anteriorly broader than the petiole; postpetiolar sides diverging posteriorly or gently convex. Anterior border of the postpetiolar sternite with a superficial triangular "lip". Posterior half of the postpetiolar sternite gently convex. Gastral tergite I slightly round. Gastral sternite I large. Remaining gastral tergites and sternites slightly curved ventrally.

Legs slender and elongate. Spurs of fore legs with a basal spine. Fore basitarsi as long as the mid ones. Hind basitarsi about 1/7 shorter than hind tibiae. Second tarsomere of hind legs 1/5 longer than the pretarsus. Pretarsal claws simple. Arolia present.

Fore wings of our type 2, hind wings of our type 1 as defined in the description of the genus (Fig. 106).

Genitalia as in Fig. 107.

Sculpture. Head, mesosoma, petiole and postpetiole minutely granulo-punctate, the punctation less marked and sparser on the postpetiole. In addition thin, irregular rugosities may be present on the head, scutellum, propodeum and metapleurae. Gaster smooth and with sparse, minute piligerous impressions. Legs superficially smooth and minutely punctate.

Pilosity similar to the one of the worker.

Colour. Black with lighter antennae and legs.

Measurements in mm and Indices: TL 3.53-4.00; HL 0.61-0.67; HW 0.66-0.72; EL 0.29-0.30; SL 0.47-0.52; WL 1.22-1.36; PeL 0.31-0.33; PeW



0.32-0.33; HFeL 0.68-0.79; HTiL 0.65-0.70; HBaL 0.55-0.60; LS4 0.50-0.60; LT4 0.81-0.97; CI 107.5 -108.2; SI 77.0-77.6; IGR 0.62.

MATERIAL EXAMINED: UNITED STATES (probably erroneously labelled): Carolina, 1 worker and 1 gyne (syntypes) [ZMBC]. CZECH REPUBLIC: Kromeriz, 1 worker, 2 gynes, 1 male, O. Fiala [MCZC, USNM]. UKRAINE: KHARKIVS'KA OBLAST': Korobotschkino, 60 km SE Charkow (today Kharkiv), 27.7.1942, H. Nowotny [ATCG]. YUGOSLAVIA: MONTENEGRO: Castelnuovo (today Herceg-Novi), 1 worker, Reitter [LACM]. ITALY: Emilia, Castelvetro, 4.IX.1922, VI.1924, 9 workers, 4 gynes, 1 male, C. Menozzi [MCSN, MCZC, NHMB, USNM]; Coazze, 1 worker, A. Dodero [MCSN]; Trieste, 1 male, Graeffe [MHNG]; Hermada-Duino, 30.III.1931, 2 workers, Tasso et. al [MCZC, MSNM]; Bardolino, Verona, 19.VIII.1957, 3 workers, B. Poldi [MMCR, MSNM]. ROMANIA:

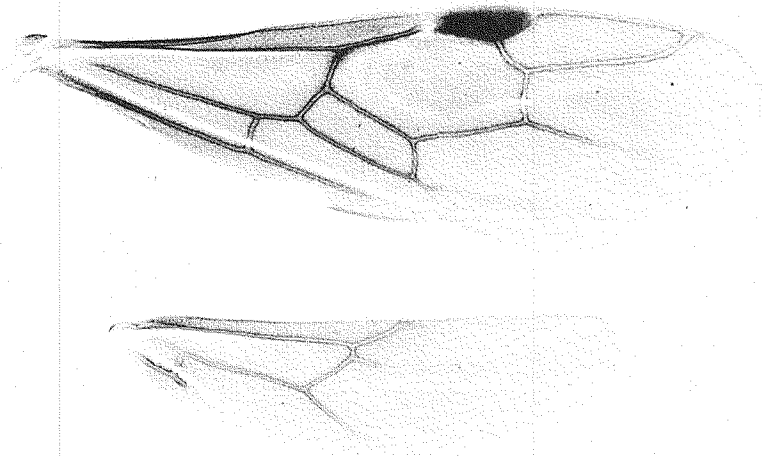


Fig. 106 – *Proceratium melinum* (Roger). Male from Male from Kromeriz, Czech Republic: fore and hind wings.

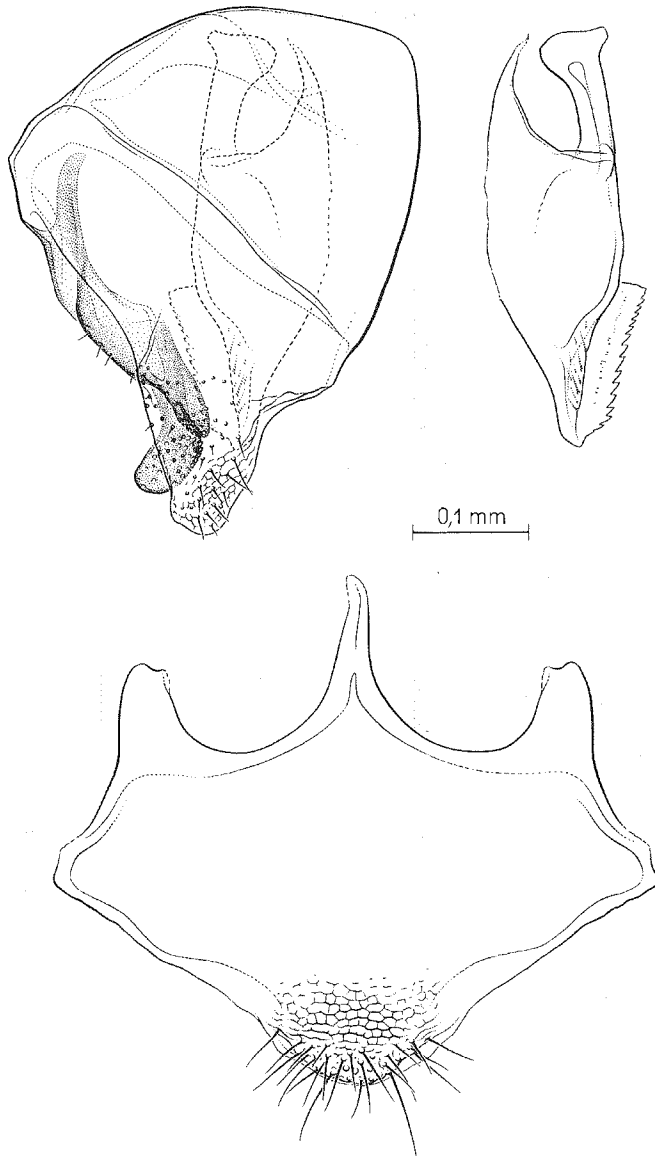


Fig. 107 – *Proceratium melinum* (Roger). Male from Kromeriz, Czech Republic. Genital appendages: a) lateral view of left parameres and of their relative positions; b) right aedeagus in profile; c) subgenital plate in ventral view.

Bucharest, 2 workers, Montandon [MCSN]; Comana Vlasca, 1 worker, Montandon [NHMB]. BULGARIA: Burgas, V.1884, 1 worker, Flach [MHNG]. ALBANIA: Avlona, 1 worker (syntype of *Sysphincta europaea*), v. Oertzen [MHNG]; same locality and collector, 1 worker [MCSN]. GREECE: CEPHALONIA: Sami, 13.IV.1970, 4 workers, B. Hauser [MHNG]; Valsamata, 11.IV.1970, 1 worker, B. Hauser [MHNG]; Argostoli, 1908, 2 workers, M. Hilf [DEIC]. LAKONIA: Sparta, 20.V.1976, 1 worker, B. Hauser [MHNG]. ITHAKI: Anoghi, 500 m, 19.IV.1972, 2 workers, B. Hauser [MHNG]. ZANTE: no further locality, 29.III.1931, 7 workers, Stolpa [MCZC]; no further locality, 22.IV.1972, 1 worker, B. Hauser [MHNG]; Vasilikon, 22.IV.1972, 1 worker, B. Hauser [MHNG]. ACHAÏA: Kastritsion, 16.III.1982, 2 workers, Lierhard [MHNG]. MESSE: Analipois, 23.III.1982, 2 workers, B. Hauser [MHNG]. RHODES: Profitis Ilias, 650 m, 11.IV.1977, 1 worker, C. Besuchet [MHNG]. TÜRKKEY: HATAY: Antakya, Yoselkent, 4.V.1978, 1 worker, C. Besuchet & I. Löbl [MHNG]. SPAIN: Prov. Castellón, Calig, 6.V.1966, 1 worker [MHNG]; Prov. Pontevedra, Mondariz, 1 worker, H. Franz [NHMW]; Prov. Granada, Encinar Navaz, S. Loja, 1 worker, 30.6.1988, A. Tinaut [ATCG].

DISCUSSION. *P. melinum*, *algiricum*, *confinium*, *melitense*, *morisitai*, *watasei*, *japonicum*, *numidicum*, *galilaeum* and *itoi* are the sole *Proceratium* species known from the Palaearctic region. The first six species belong to the *pergandei* clade and *melinum* is the one with the broadest distribution.

The known distribution of this species in the Iberian Peninsula is detailed by Tinaut & Martínez-Ibáñez (1998). Kugler (1988) reports this species from Israel, a country from which we did not see any specimen. The account, however, represents the southernmost record for this species and appears as biogeographically plausible. The northernmost distributional record for *melinum* appears to be the one from S. Poland (Cracow) given above.

DISTRIBUTION: Central and Southern Europe from South Spain to Russia, Turkey, and Israel.

**Proceratium morisitai** Onoyama & Yoshimura

Figs. 108, 109, 110

*Proceratium itoi* (Forel), Sonobe, 1974: 2, fig. 4. Worker. Misidentification detected by Onoyama & Ogata, 1989.

*Proceratium* sp. JADG, 1998: figs. PCD0419/C/95-97. Worker.

*Proceratium* sp. 4, Onoyama & Ogata, 1989: 15, fig. 3.26b. Worker.

*Proceratium morisitai* Onoyama & Yoshimura, 2002: 40, figs. 1, 3, 13-15, 52, 56 (worker), 25-27, 51, 73, 74 (gyne), 39-42, 75, 76 (male), 61-63 (male genitalia). Original description. Type locality: Kamigamo-nakayama-cho, Kita-ku, Japan. Type material: 3 paratype workers, 1 paratype gyne and 1 paratype male labelled: "Kamigamo-nakayanacho, Kita-ku, Kyoto, Japan, 100 m alt., A. Taki leg, 10.X.1991, K. Onoyama & M. Yoshimura, det. XII.2000. *Proceratium morisitai*; Paratype" in NHMB (1 worker, 1 gyne and 1 male), LACM (1 worker) and MRSN (1 worker), examined.

DIAGNOSIS. A *Proceratium* species belonging to the *pergandei* clade where it appears in the basalmost position and differing from its next in-group species, *melinum*, in the worker and gyne, by the head sculpture granulate instead of rugosopunctate and by the second tarsomere of the hind legs about as long as the pretarsus instead of 1/5 longer than the pretarsus, and, in the male by the IGR = 0.68 instead of 0.62.

DESCRIPTION. *Worker* (Fig. 108). Head longer than broad, its sides gently convex in the two anterior thirds and converging in the posterior third. Anteromedian part of the clypeus narrow, triangular and protruding anteriorly, with a marked longitudinal carina dorsally. Frontal carinae diverging posteriorly, weakly raised and not close to each other. Lateral expansions of the frontal carinae narrow. Genal carina absent. Gular area not impressed. Eyes absent or small and represented by a dark dot below the integument. This pigmented area, when present, on the midline of the head. First funicular joint about as long as broad. Funicular joints 2-10 about as broad as long or slightly broader than long. Last funicular joint about as long as the sum of joints 7-10. Scapes much short of vertexal margin and gently thickening apically. Masticatory margin of the mandibles with 4-6 denticles before the pointed apical tooth. Palp formula 4,3.

Mesosoma about as long as the maximum head length (mandibles included). Propodeal suture weakly impressed dorsally. Basal face of the propodeum gently declivous posteriorly. Area between basal and declivous

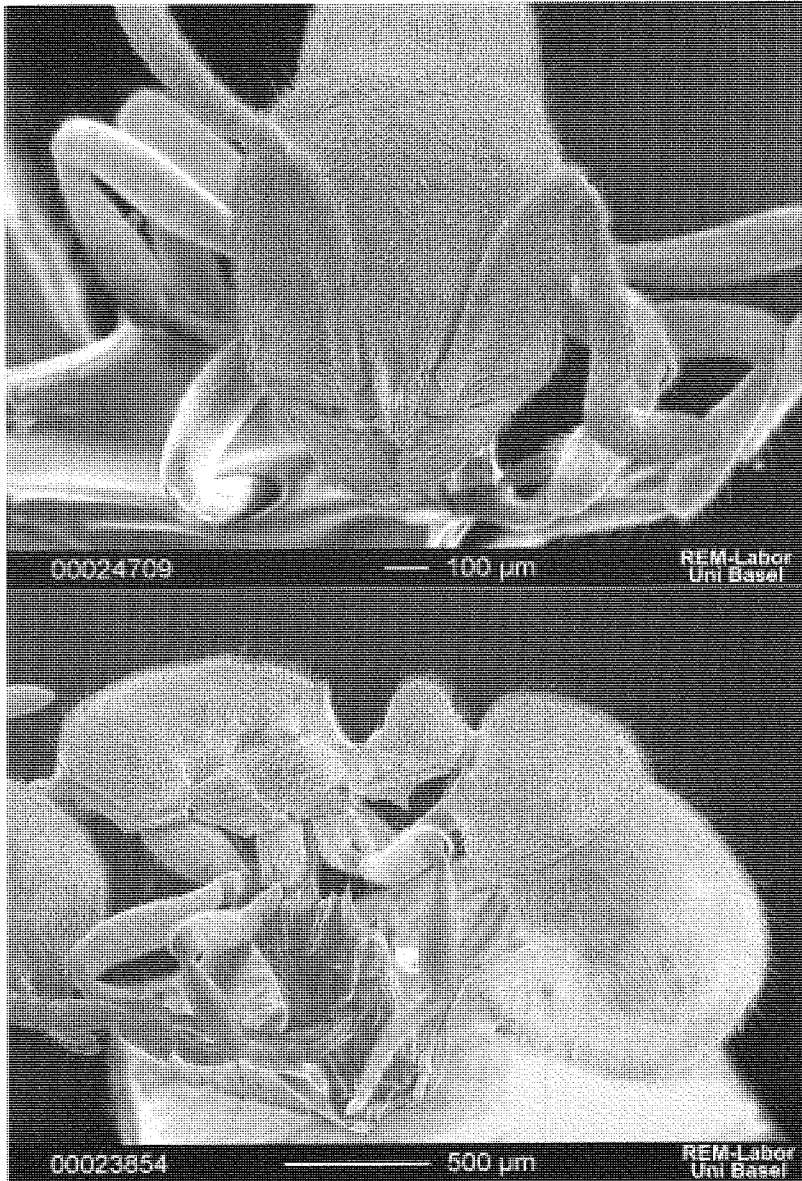


Fig. 108 – *Proceratium morisitai* Onoyama & Yoshimura. Worker (paratype) from Kamigamo-nakayama-cho, Kita-ku, Kyoto, Japan: head (top) in dorsal view and meso- and metasoma (bottom) in side view.

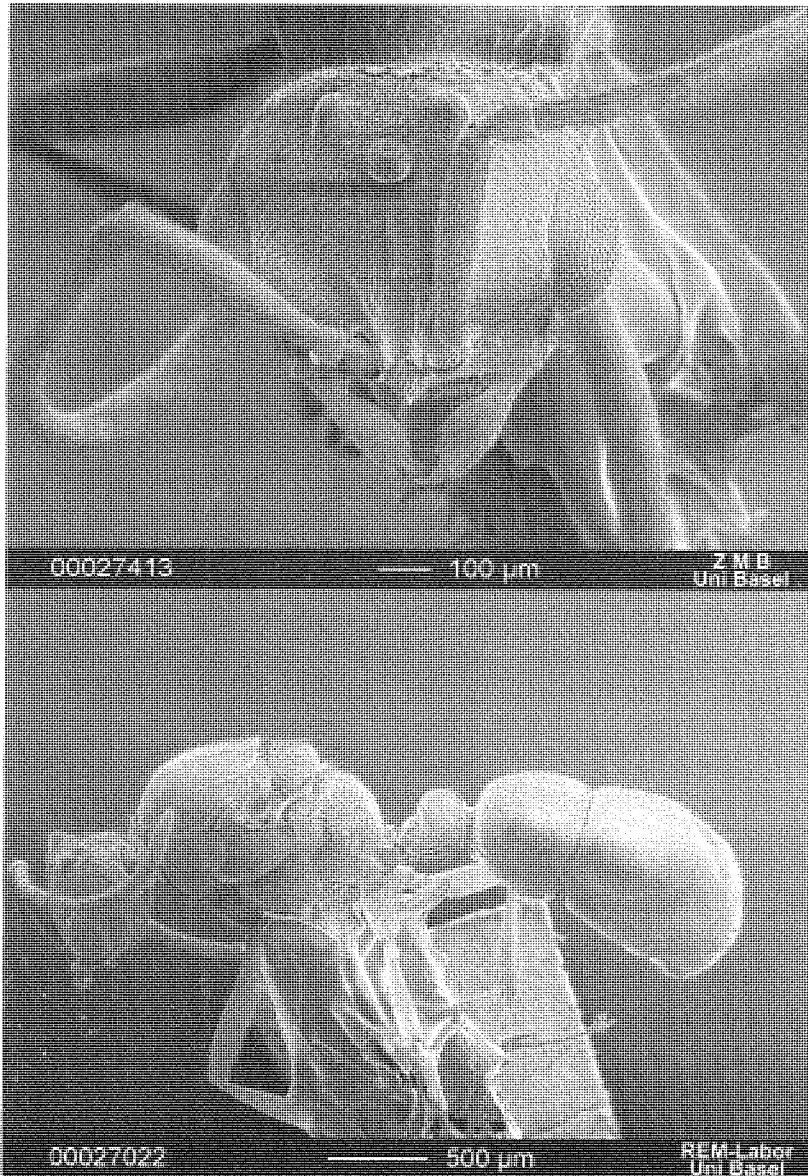


Fig. 109 – *Proceratium morisitai* Onoyama & Yoshimura. Male (paratype) from Kamigamonakayama-cho, Kita-ku, Kyoto, Japan: head (top) in dorsal view and meso- and metasoma (bottom) in side view.

faces of the propodeum gently concave and separated laterally by a denticle. Declivous face of the propodeum flat and with marginate sides. Propodeal lobes round and lamellaceous. Propodeal spiracle round and above the mid height in lateral view.

Petiole slightly longer than broad, convex in side view and with the sides diverging on the anterior fourth and convex posteriorly in dorsal view. Anterior border of the petiole concave and carinate, the carina forming a denticle on each side. Ventral process of the petiole lamelliform and pointed posteriorly. Postpetiole anteriorly broader than the petiole; its sides gently convex. Postpetiolar sternite anteromedially with a marked subtriangular projection. Posterior half of the postpetiolar sternite strongly convex. Constriction between postpetiole and first gastral segment impressed. Gastral tergite I strongly convex on the curvature. Remaining gastral tergites and sternites curved ventrally.

Legs slender but not very elongate. All tibiae with a pectinate spur. Spurs of fore legs with basal spine. Fore basitarsi longer than the mid ones. Hind basitarsi about 1/5 shorter than hind tibiae. Second tarsomere of hind legs about as long as the pretarsus. Pretarsal claws simple. Arolia large.

Sculpture. Head, mesosoma, petiole and postpetiole strongly granulate. Second gastral segment superficially shining and covered by piligerous impressions. Legs punctate.

Pilosity. Body covered by hairs of three main types: (1) short, dense, subdecumbent on the whole body, sparse and suberect on the funicular joints; (2) longer than type (1), sparse and suberect on the whole body, absent on the funiculi; (3) shorter than hair type (1), dense and decumbent on the funicular joints only. In addition the funicular joints bear whitish, thick, appressed, short, sparse hairs, and the scapes with sparse hairs shorter than hair type (2).

Colour yellowish to light brown.

Measurements in mm and Indices: TL 3.64-4.25; HL 0.78-0.91; HW 0.70-0.80; EL 0.03-0.04; SL 0.56-0.66; WL 1.00-1.16; PeL 0.33-0.37; PeW 0.28-0.33; HFeL 0.59-0.73; HTiL 0.52-0.64; HBaL 0.41-0.51; LS4 0.37-0.42; LT4 0.86-1.04; CI 87.9-89.7; SI 71.1-72.8; IGR 0.40-0.43.

*Gyne*. Differing from the worker in the following details: eyes large, slightly more than 1/5 of the head length and with well defined ommatidia.

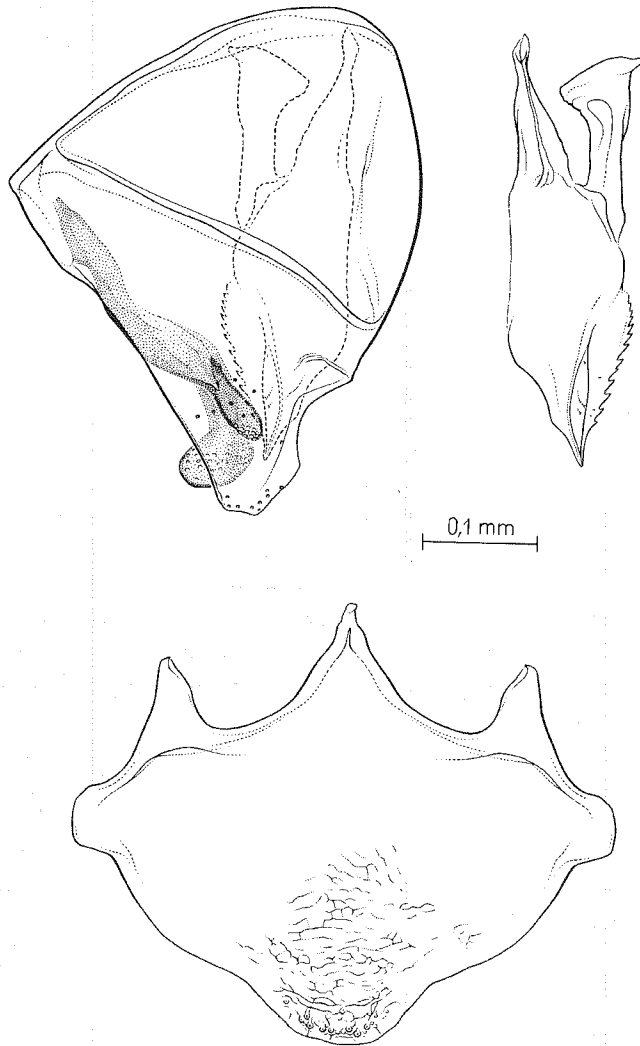


Fig. 110 – *Proceratium morisitai* Onoyama & Yoshimura. Male from Kamigamo-nakayama-cho, Kita-ku, Kyoto, Japan. Genital appendages: a) lateral view of the left parameres and of their relative positions; b) right aedeagus in profile; c) subgenital plate in ventral view.



Ocular pilosity present. Ocelli present. Mesosoma robust. Scutellum large, slightly longer than the length of the basal face; its sides gently converging to a convex posterior border. Metanotum with traces of a minute denticle.

Fore wings of our type 2, hind wings of our type 1 as defined in the description of the genus.

Measurements in mm and Indices: TL 4.66; HL 0.92; HW 0.82; EL 0.20; SL 0.63; WL 1.32; PeL 0.39; PeW 0.34; HFeL 0.78; HTiL 0.66; HBaL 0.53; LS4 0.52; LT4 1.20; CI 89.1; SI 68.5; IGR 0.43.

*Male* (Fig. 109). Head slightly broader than long. Vertex in full face view convex. Vertexal margin carinate. Clypeus subround; its dorso-median part with a superficial longitudinal carina reaching the anterior ocellus. Frontal carinae thin, slightly diverging posteriorly. Frontal area gently concave. Ocelli large. Compound eyes large and placed mostly on the anterior part of the head sides. Scapes almost reaching the vertexal margin. First funicular joint about 1/5 longer than broad, thicker and about 1/2 as long as the second joint. Joints 2-11 longer than broad. Last funicular joint slightly longer than the sum of joints 10-11. Mandibles with 3-4 minute denticles before the pointed apical tooth. Palp formula apparently 4.3.

Mesosoma robust. Pronotum and anterior third of mesonotum almost perpendicular to the posterior two thirds of the mesonotum. Posterior two thirds of mesonotum almost flat. Parapsidal furrows marked. Scutellum as high as the mesonotum; posterior border of the scutellum round. Propodeum without clearly differentiated basal and declivous faces, gently convex and unarmed in profile. Metanotum with a median, carinate denticle. Propodeal lobes round. Propodeal spiracles small.

Petiole slightly longer than broad, declivous in the anterior third and convex in the two posterior thirds in side view. Sides of the petiole subparallel in the anterior third and gently convex posteriorly in dorsal view. Anterior border of the petiole concave, carinate and laterally angulate. Subpetiolar process lamellaceous and medially pointed. Postpetiole anteriorly broader than the petiole; postpetiolar sides gently convex. Anterior border of the postpetiolar sternite with a triangular "lip". Posterior half of the postpetiolar sternite gently convex. Gastral tergite I slightly round. Gastral sternite I large. Remaining gastral tergites and sternites slightly curved ventrally.

Legs slender and elongate. Spurs of fore legs with basal spine. Hind ba-

sitarsi about 1/7 shorter than hind tibiae. Second tarsomere of hind legs longer than the pretarsus. Pretarsal claws simple. Arolia large.

Fore wings of our type 2, hind wings of our type 1 as defined in the description of the genus.

Genitalia as in Fig. 110.

Sculpture. Head, mesosoma, petiole and postpetiole minutely granu-lopunctate. In addition the head, scutellum, propodeum and metapleurae with thin, irregular, rugosities. Gaster smooth and with sparse, minute piligerous impressions. Legs with sparse, minute punctures.

Pilosity similar to the worker.

Colour. Dark brown-black with lighter antennae and legs.

Measurements in mm and Indices: TL 3.64; HL 0.62; HW 0.67; EL 0.29; SL 0.48; WL 1.24; PeL 0.31; PeW 0.27; HFeL 0.78; HTiL 0.66; HBaL 0.57; LS4 0.57; LT4 0.84; CI 108.0; SI 77.4; IGR 0.68.

MATERIAL EXAMINED: JAPAN: KYOTO: Kamigamo-nakayama-cho, Kitaku, 10.X.1991, 100 m alt., 3 workers, 1 gyne and 1 male (all paratypes), A. Taki [LACM, MRSN, NHMB]. MIE: Yokkaichi, 1.V.1987, 1 worker, A. Amagasu [MTCS]. TOKYO: Shinjyuku, 10.V.1981, 1 worker, S. Kubota [MTCS].

DISCUSSION. *P. morisitai* is very similar to *melinum* in body shape. *Morisitai*, moreover, exhibits an integumental sculpture similar to the one of the three members of its outgroup clade, *itoi*, *bhutanense* and *malesianum*. *P. morisitai*, however, possesses the spur of the fore legs with a basal spine as all other members of the *pergandei* clade, a character absent in the three members of the *itoi* clade. Onoyama & Yoshimura (2002) describe the peg-like structure of the last antennal joint differing from the one of the other Japanese species. A similar structure, however, in this same clade, is present in *P. croceum* (Fig. 154) and absent in *sulawense* (Fig. 152).

DISTRIBUTION: Japan.

## THE *ITOI* CLADE

This small clade includes 3 species only: *bhutanense*, *itoi*, and *malesianum*. The workers of this clade share the following character: first gastral sternite (fourth abdominal) protruding over the third abdominal sternite (postpetiole) (Fig. 110).

### **Proceratium itoi** (Forel)

Figs. 111, 112, 113, 114

*Sysphincta itoi* Forel, 1918: 717. Worker. Original description. Type locality: Tokyo, Japan. Type material: 3 syntype workers labelled: "*Sysphincta itoi* For., worker type, Tokio, Japan (Ito)" in MHNG, examined.

*Proceratium itoi* (Forel), Brown, 1958a: 247. First combination in *Proceratium*.

*Proceratium itoi* (Forel), Choi, 1986: 341.

*Proceratium itoi* (Forel), Ogata, 1987: 107. Male. Figs. 17 (worker), 20-21 (male), 23-28 (male genitalia).

*Proceratium itoi* (Forel), Onoyama & Ogata, 1989: 15, figs. 3.23b, 3.25b, 3.26a. Worker.

?*Proceratium itoi* (Forel), Choi & Park, 1991a: 69.

?*Proceratium itoi* (Forel), Choi & Park, 1991b: 83.

?*Proceratium itoi* (Forel), Wu & Wang, 1995: 35, fig. 15 (worker).

?*Proceratium itoi* (Forel), Tang et al., 1995: 29, fig. 25 (worker).

*Proceratium itoi* (Forel), JADG, 1998: figs. PCD1328/C/04-06. Worker.

*Proceratium itoi* (Forel), Onoyama & Yoshimura, 2002: 32, figs. 7-9, 48 (worker), 19-21, 47, 65, 66 (gyne), 31-34, 57-59, 67, 68 (male).

**DIAGNOSIS.** A *Proceratium* species belonging to the *itoi* clade and differing from the two in-group species, *bhutanense* and *malesianum*, in the worker, by the palp formula 4,3 instead 3,2 and by the broader frontal carinae, from *bhutanense* only, by the presence of erect hairs over the whole body, and from *malesianum* only, by the mid basitarsi with hairs never as much as 1/2 of the mid basitarsal length.

**DESCRIPTION.** *Worker* (Fig. 111). Head longer than broad, its sides weakly convex. Vertex in full face view almost straight. Clypeus medially reduced, triangular, between and slightly longer than the antennal socket. Clypeal dorsum with a longitudinal carina. Antennal socket with broad torulus. Frontal carinae far each other, partially covering the antennal inser-

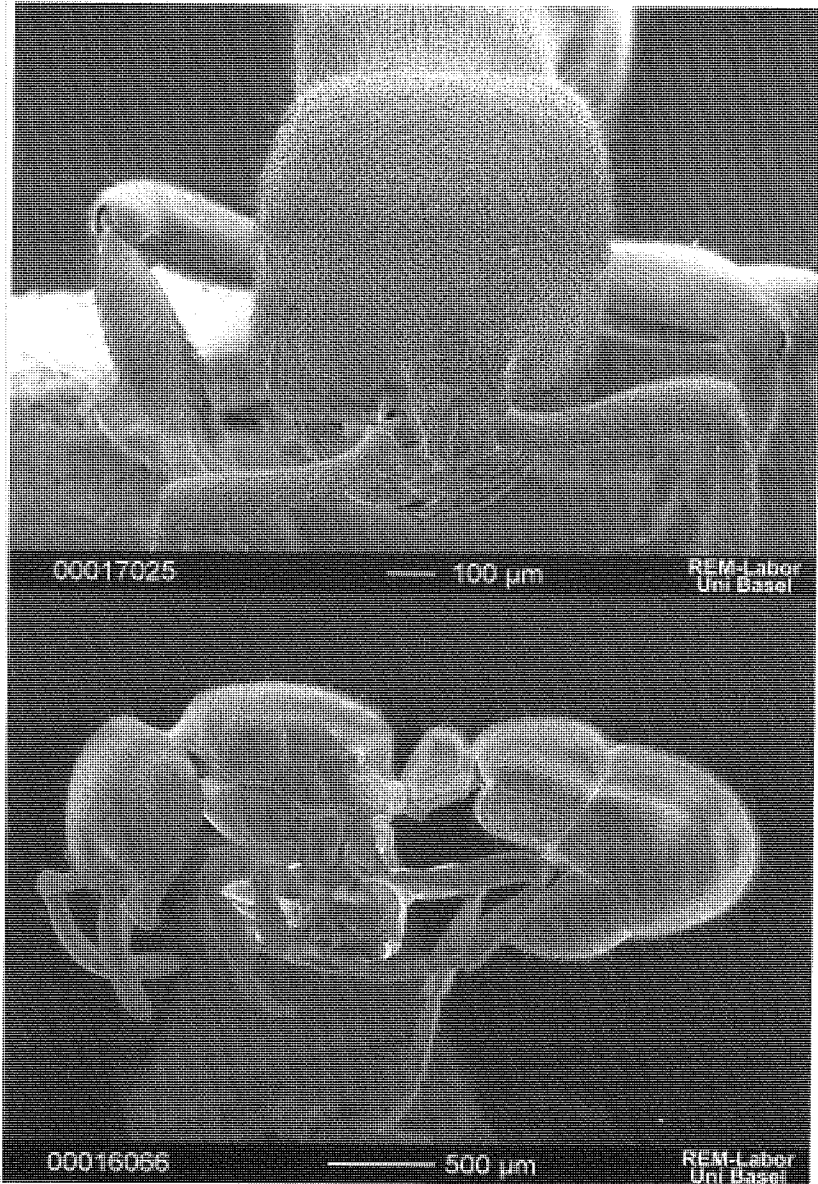


Fig. 111 – *Proceratium itoi* Forel. Worker from Odawara, Kanagawa, Japan: head (top) in dorsal view and meso- and metasoma (bottom) in side view.

tions. Frontal area behind the frontal carinae convex. Lateral expansions of the frontal carinae relatively narrow, raised, diverging. Genal carinae prominent. Eyes small, represented by a dark dot below the integument. Eyes on the midline of the head. First funicular joint subequal in length and width. Funicular joints 2-10 much broader than long. Last funicular joint about as long as the sum of joints 7-10. Scapes clearly not reaching the vertexal margin and gently thickening apically. Masticatory margin of the mandibles with 3-4 denticles before the pointed apical tooth. Palp formula 4,3.

Mesosoma slightly longer than the maximum head length (mandibles included). Promesopleural and meso-metapleural sutures impressed ventrally only. Basal face of the propodeum weakly declivous. Declivous face of the propodeum gently concave. Basal and declivous faces of the propodeum separate laterally by a weakly carinate angle. Sides of the declivous face of the propodeum carinate. Propodeal lobes surrounded by a narrow lamella. Propodeal spiracle round and above mid height in lateral view.

Petiole in profile with declivous anterior face and convex posteriorly. Petiole in dorsal view with diverging sides and convex posteriorly. Anterior border of the petiole variably concave and carinate, the carina denticulate on each side. Ventral process of the petiole small and triangular. Postpetiole anteriorly broader than the petiole; its sides diverging or gently convex. Postpetiolar sternite anteromedially with a weakly marked subtriangular projection. Postpetiolar sternite straight in side view. Constriction between postpetiole and first gastral segment impressed. Gastral tergite I strongly convex on the curvature. Remaining gastral tergites and sternites curved ventrally.

Legs slender but not very elongate. All tibiae with a pectinate spur. Spurs of fore legs without a basal spine. Fore basitarsi longer than the mid ones. Hind basitarsi about 1/4 shorter than hind tibiae. Second tarsomere of hind legs shorter than pretarsus. Pretarsal claws simple. Arolia present.

Sculpture. Head, mesosoma, petiole and postpetiole granulate. First gastral tergite smooth and covered by piligerous punctures; its sides and the posterior border with additional granulation. Legs granulate, the granulation less marked than in the other body parts.

Pilosity. Body covered by hairs of three main types: (1) short, dense, subdecumbent on the whole body, sparse and suberect on the funicular joints; (2) longer than type (1), sparse, erect or suberect on the whole body,

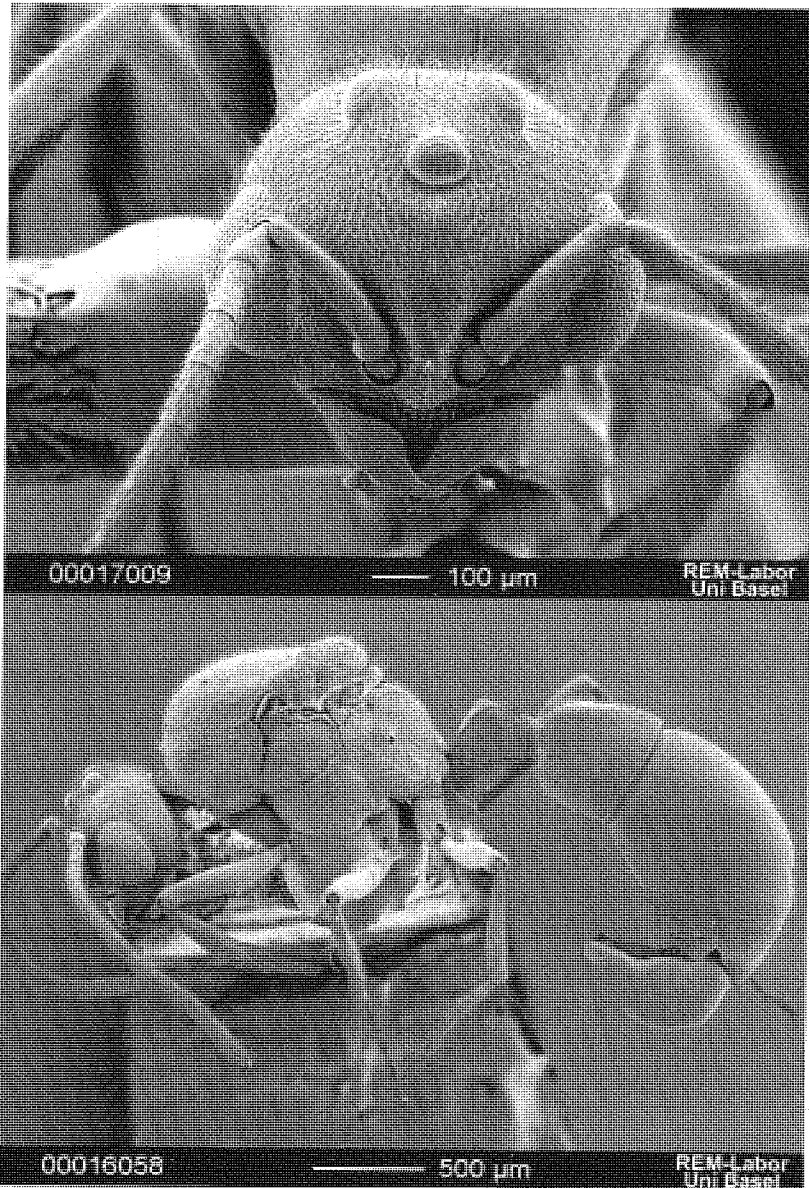


Fig. 112 – *Proceratium itoi* Forel. Male from Odawara, Kanagawa, Japan: head (top) in dorsal view and meso- and metasoma (bottom) in side view.

slightly shorter on the scapes, absent on the funiculi; (3) shorter than hair type (1), dense and decumbent on the funicular joints only. In addition the funicular joints bear whitish, thick, appressed, sparse hairs.

Colour brown.

Measurements in mm and Indices: TL 3.65-3.82; HL 0.81-0.83; HW 0.71-0.74; EL 0.03; SL 0.49-0.50; WL 1.00-1.04; PeL 0.32-0.35; PeW 0.31-0.32; HFeL 0.64; HTiL 0.53-0.56; HBaL 0.38-0.41; LS4 0.25-0.30; LT4 0.86-0.92; CI 87.6-89.1; SI 60.2-60.5; IGR 0.34-0.35.

*Gyne*. Differing from the worker in the following details: eyes about 1/5 of the head length and with well defined ommatidia. Ocular pilosity present. Ocelli present.

Mesosoma robust. Scutellum large; its sides converging into a convex posterior border. Basal face of the propodeum gently declivous posteriorly; dorsally medially incised and as flat as the declivous face; its sides subangulate and carinate. Metanotum without denticle. Propodeal lamellae narrower.

Measurements in mm and Indices: TL 4.46-4.62; HL 0.86-0.88; HW 0.78-0.81; EL 0.17; SL 0.51; WL 1.28-1.32; ; PeL 0.38-0.40; PeW 0.37; HFeL 0.75; HTiL 0.61-0.62; HBaL 0.46; LS4 0.36-0.38; LT4 1.10-1.12; CI 90.7-92.0; SI 57.9-59.3; IGR 0.33-0.34.

*Male* (Fig. 112). Head subequal in size or slightly broader than long. Vertex in full face view convex. Vertexal margin carinate. Clypeus dorsomedially convex. Frontal carinae thin, low, diverging posteriorly. Frontal area with a sulcus. Ocelli large. Compound eyes large and placed mostly on the anterior part of the head sides. Scapes reaching the anterior ocellus. First funicular joint about 1/4 shorter than second joint. Joints 2-12 longer than broad. Last funicular joint slightly longer than the sum of joints 10-11. Mandibles edentate and only with a pointed apical tooth. Palp formula 4,3.

Mesosoma robust. Pronotum and anterior third of mesonotum almost perpendicular to the posterior two thirds of the mesonotum. Posterior two thirds of mesonotum almost flat. Parapsidal furrows marked. Scutellum slightly higher than the mesonotum; its posterior border round. Basal and declivous faces of the propodeum convex in side and dorsal view. Sides of the propodeum gently converging. Declivous face of propodeum laterally superficially carinate. Metanotum with a median tooth. Propodeal lobes round and partially lamellaceous. Propodeal spiracles small.

Petiole in profile declivous in the anterior third and convex in the two posterior thirds. Sides of the petiole convex in dorsal view. Anterior border of the petiole concave and laterally carinate. Subpetiolar process absent; petiolar sternite gently convex. Postpetiole anteriorly broader than the petiole; postpetiolar sides diverging posteriorly. Anterior border of the postpetiolar sternite with a superficial triangular "lip". Gastral tergite I large and convex in side view. Remaining gastral tergites and sternites slightly curved ventrally.

Legs as in the worker but more elongate. Hind basitarsi slightly shorter than hind tibiae.

Fore wings of our type 2, hind wings of our type 3 as defined in the description of the genus (Fig. 113).

Genitalia as in Fig. 114.

Sculpture. Head irregularly reticulorugose. Mesosoma minutely granulo-punctate, the granulation more superficial on the mesonotum. Scutellum,



Fig. 113 – *Proceratium itoi* Forel. Male from Manazurumisaki, Kanagawa, Japan: fore and hind wings.



propodeum and pleurae with additional, thin, irregular rugosities. Postpetiole and gaster smooth and with minute piligerous punctures. Legs minutely granulopunctate.

Pilosity as in the worker but with hairs of type (2) sparser on the petiole, postpetiole and gaster.

Colour. Back with lighter antennae and legs.

Measurements in mm and Indices: TL 3.63-3.74; HL 0.59-0.60; HW 0.61-0.64; EL 0.30-0.31; SL 0.33; WL 1.20-1.28; PeL 0.34-0.35; PeW 0.25-0.26; HFeL 0.76-0.79; HTiL 0.65; HBaL 0.58-0.60; LS4 0.48; LT4 0.84; CI 103.4-106.7; SI 55.0-55.9; IGR 0.57.

MATERIAL EXAMINED: JAPAN: TOKYO: Tokyo, 3 workers (syntypes), Ito [MHNG]. KANAGAWA: Odawara, 27.VIII.1976, 1 worker, 1 gyne, 2 males, M. Kubota [MCZC]; Manazurumisaki, 14.IX.1981, 1 male, K. Masuko [NHMB]; Kamakura, 10.VI.1984, 1 worker, H. Nagase [LACM]. Nara: Nara, 27-31.VII.1980, 3 workers, C. Besuchet [MHNG]. KYOTO: Kitashirakawaoiwake-cho, Sakyo-ku, 60m alt., captured with a light trap placed at the 3rd floor of Department of Zoology (Laboratory of Ecology), Faculty of Science, Kyoto University, 29.viii.1974, 1 male, K. Onoyama [NHMB]. HYOGO: Takarazuka, 2-3.VI.1970, 3 workers, 1 gyne, M. Tanaka [NHMB]. OSAKA: Tennoji, 11.IX.1945, 1 gyne, M. Azuma [USNM].

DISCUSSION. For the illustration of the gyne, not given in the present paper, we refer to Onoyama & Yoshimura (2002).

The trifurcate subgenital plate of *itoi*, already figured by Ogata (1987) and Onoyama & Yoshimura (2002), is unique among the species of this genus dissected so far. The male genitalia of the other two species belonging to the same clade, however, are still unknown.

Wu & Wang (1995) and Tang et al. (1995) report this species from the Chinese provinces of Zhejiang and Hunan. As already noted by Onoyama & Yoshimura (2002), the figures of both papers are too rough to allow any guess on the identity of these records. Similar considerations might apply to the Korean records by Choi (1986), and by Choi & Park (1991a and 1991b). We were unable to examine any Chinese or Korean specimens of this species. All these record, however, are geographically plausible.

DISTRIBUTION: Japan, China?, Korea?

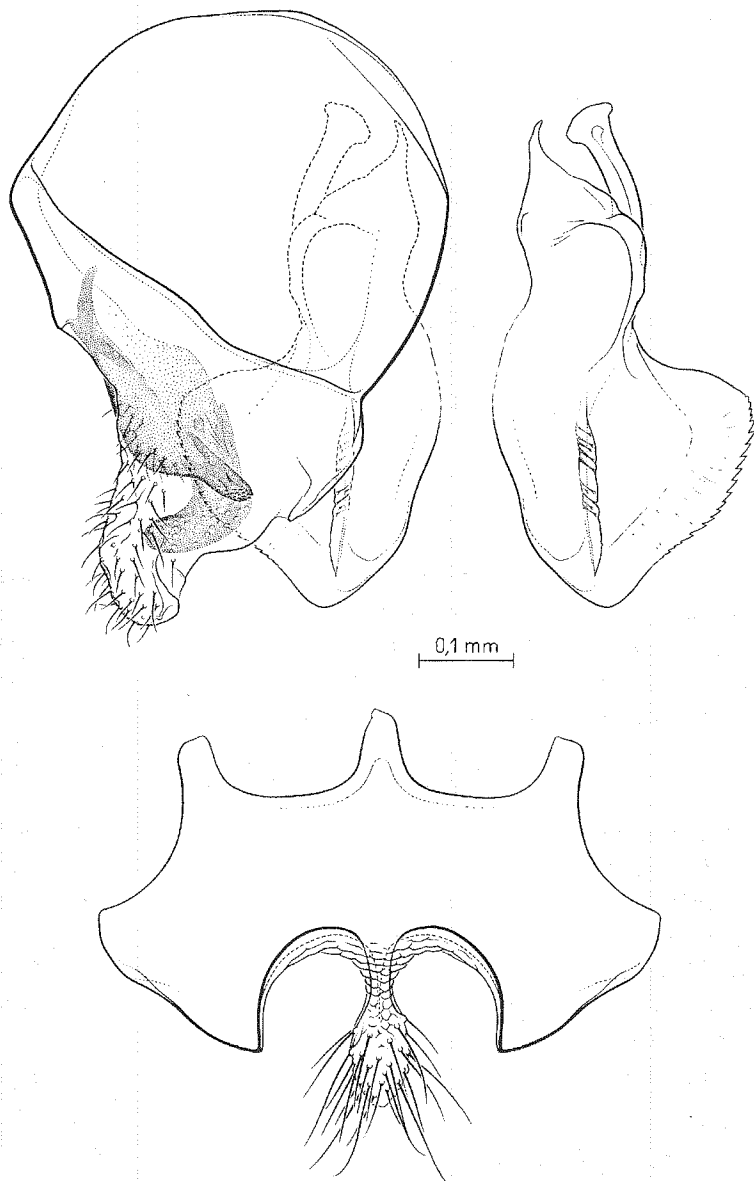


Fig. 114 – *Proceratium itoi* Forel. Male from Odawara, Kanagawa, Japan. Genital appendages: a) lateral view of left parameres and of their relative positions; b) right aedeagus in profile; c) subgenital plate in ventral view.

**Proceratium malesianum** de Andrade n. sp.

Fig. 115

TYPE MATERIAL: holotype worker from West Malaysia labelled: "W. Malaysia: Pahang, Ringlet. 1250 m, ravine # 20, Löbl & Calame, 26.3.93", in MHNG.

DERIVATIO NOMINIS: "*malesianum*" is a neologism indicating the provenance of this species from Malaysia.

DIAGNOSIS. A *Proceratium* species differing from its sister species *bhutanense* by the presence of erect hairs in the worker.

DESCRIPTION. *Worker* (Fig. 115). Head longer than broad, its sides subparallel. Vertex in full face gently convex. Clypeus medially reduced, triangular, between and slightly longer than the antennal sockets. Clypeal dorsum with longitudinal carina. Antennal socket with broad torulus. Frontal carinae slightly far from each other, partially covering the antennal insertions. Frontal area behind the frontal carinae convex. Lateral expansions of the frontal carinae relatively narrow, raised, and diverging. Genal carinae marked. Eyes small, reduced to a dark dot below the integument, placed on the midline of the head. First funicular joint subequal in size. Funicular joints 2-10 much broader than long. Last funicular joint about as long as the sum of joints 6-10. Scapes much short of the vertexal margin and gently thickening apically. Masticatory margin of the mandibles with 3 denticles before the pointed apical tooth. Palp formula 3,2.

Mesosoma slightly longer than the maximum head length (mandibles included). Promesopleural and meso-metapleural sutures impressed ventrally only. Basal face of the propodeum weakly declivous. Declivous face of the propodeum gently concave anteriorly. Basal and declivous faces of the propodeum separate laterally by a weakly carinate angle. Sides of the declivous face of the propodeum with a broad lamella. Propodeal spiracle round and placed above mid height in lateral view.

Petiole strongly convex in profile, with the sides diverging and strongly convex posteriorly in dorsal view. Anterior border of the petiole deeply concave and carinate, the carina strongly denticulate on each side. Ventral process of the petiole with 2-4 small, triangular denticles. Postpetiole anteriorly broader than the petiole; its sides diverging and gently convex posteriorly. Postpetiolar sternite anteromedially with a marked subtriangular pro-

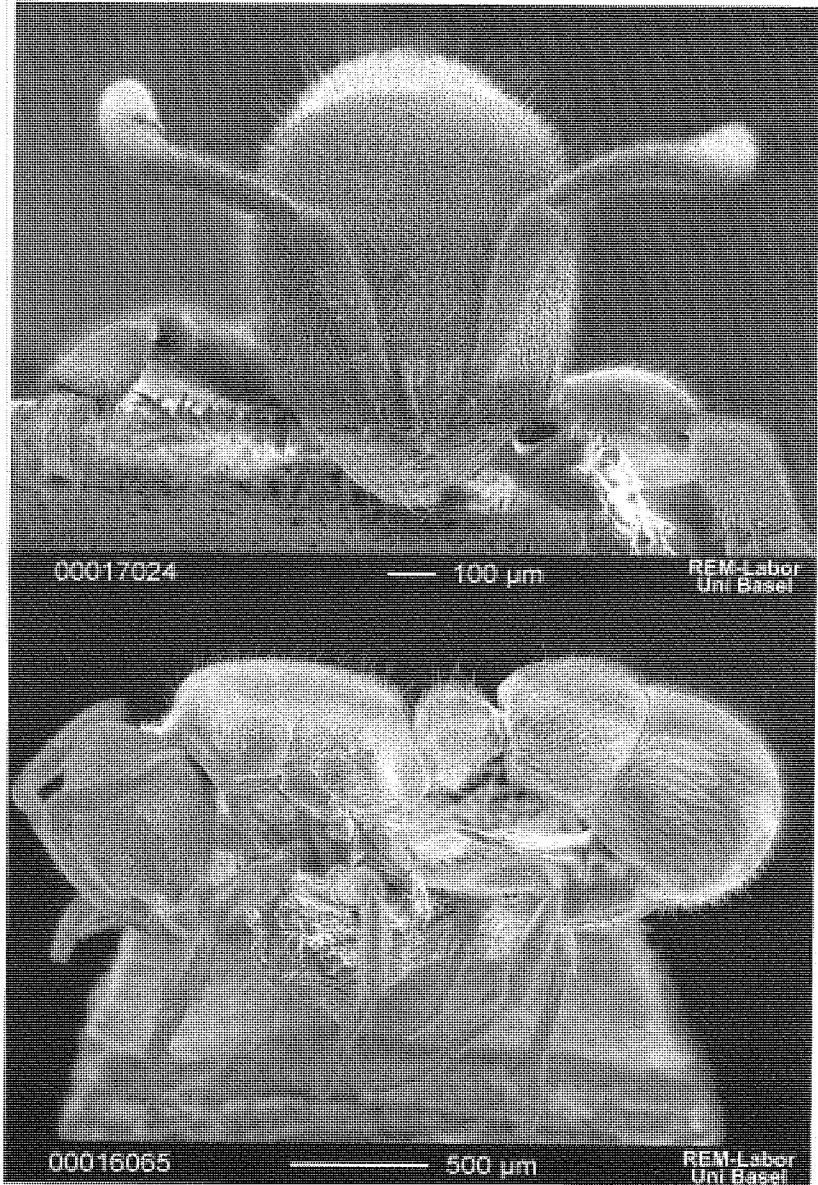


Fig. 115 – *Procerantium molestianum* de Andrade. Worker from Cameron Highlands, Pahang, West Malaysia: head (top) in dorsal view and meso- and metasoma (bottom) in side view.

jection. Postpetiolar sternite straight in profile. Constriction between postpetiole and first gastral segment impressed. Gastral tergite I strongly convex on the curvature. Remaining gastral tergites and sternites curved ventrally.

Legs slender but not very elongate. All tibiae with a pectinate spur. Spurs of fore legs without basal spine. Fore basitarsi longer than the mid ones. Hind basitarsi about 1/3 shorter than hind tibiae. Second tarsomere of hind legs subequal to the fourth. Pretarsal claws simple. Arolia present.

Sculpture. Head, mesosoma, petiole and postpetiole granulate. First gastral tergite smooth and covered by piligerous punctures; its sides and the posterior border with additional granulation. Legs granulate, the granules less marked than in the other body parts.

Body covered by hairs of three main types: (1) short, dense, subdecumbent on the whole body, sparse and suberect on the funicular joints; (2) longer than type (1), sparse and suberect on the whole body, slightly shorter on the scapes, absent on the funiculi; (3) shorter than hair type (1), dense and decumbent on the funicular joints only. In addition the funicular joints bear whitish, thick, appressed, short, sparse hairs.

Colour. Dark brown.

Measurements in mm and Indices: TL 2.57-3.24; HL 0.61-0.75; HW 0.53-0.65; EL 0.03-0.04; SL 0.36-0.45; WL 0.71-0.90; PeL 0.26-0.32; PeW 0.24-0.29; HFeL 0.43-0.55; HTiL 0.35-0.49; HBaL 0.21-0.31; LS4 0.20-0.27; LT4 0.57-0.72; CI 87.0; SI 59.0-60.0; IGR 0.35-0.38.

MATERIAL EXAMINED: MALAYSIA: PAHANG: Ringlet, 26.III.1993, 1250 m, 1 worker (holotype), I. Löbl & Calame [MHNG]; Cameron Highlands, 1720 m, Gunung Jasar, 25.III.1993, 1 worker, I. Löbl & Calame [BMNH].

DISCUSSION. *P. malesianum* appears to be the sister species of *bhutanense* with which it shares synapomorphically the palp formula 3,2 and the presence of a propodeal lamella. The two species are easily distinguished by the erect hairs present in *malesianum* and absent in *bhutanense*.

DISTRIBUTION: Malaysia (Pahang).

**Proceratium bhutanense** de Andrade n. sp.

Figs. 116, 117

TYPE MATERIAL: holotype worker from Phuntsholing, Bhutan labelled: "Phuntsholing, 2/400 m, 15.4, Nat. – Hist. Museum Basel – Bhutan Expedition 1972" in NHMB; 1 paratype worker same data and collection as the holotype; 1 paratype worker in MRSN.

DERIVATIO NOMINIS: "*bhutanense*" is a neologism indicating the provenance of the species from Bhutan.

DIAGNOSIS. A *Proceratium* species differing from its sister species, *malesianum*, by the absence of erect hairs in the worker.

DESCRIPTION. *Worker* (Figs. 116, 117). Head slightly longer than broad, its sides subparallel anteriorly and gently converging posteriorly. Vertex in full face view straight. Clypeus medially reduced, triangular or subround, between and slightly longer than the antennal sockets. Clypeal dorsum with longitudinal carina. Antennal socket with broad torulus. Frontal carinae separate from each other, partially covering the antennal insertions. Frontal area behind the frontal carinae convex. Lateral expansions of the frontal carinae relatively narrow, raised, diverging. Genal carinae marked. Eyes small, appearing as a dark dot below the integument and placed on the midline of the head. First funicular joint subequal in length and width. Funicular joints 2-10 much broader than long. Last funicular joint about as long as the sum of joints 6-10. Scapes much short of the vertexal margin and gently thickening apically. Masticatory margin of the mandibles with 2-3 denticles before the pointed apical tooth. Palp formula 3,2.

Mesosoma slightly longer than the maximum head length (mandibles included). Promesopleural and meso-metapleural sutures impressed ventrally only. Basal face of the propodeum weakly declivous. Declivous face of the propodeum gently concave anteriorly. Basal and declivous faces of the propodeum laterally separate by a carinate denticle or tooth. Sides of the declivous face of the propodeum with a lamella broader posteriorly. Propodeal spiracle round and above the mid height in lateral view.

Petiole convex in profile, with the sides diverging and convex posteriorly in dorsal view; petiolar node relatively flat. Anterior border of the petiole deeply concave and carinate, the carina strongly denticulate on each side.

Ventral process of the petiole triangular or spiniform. Postpetiole broader than the petiole anteriorly; its sides diverging and gently convex posteriorly. Postpetiolar sternite anteromedially with a superficially marked subtriangular projection and straight in side view. Constriction between postpetiole and first gastral segment impressed. Gastral tergite I strongly convex on the curvature. Remaining gastral tergites and sternites curved ventrally.

Legs slender but not very elongate. All tibiae with a pectinate spur. Spurs of fore legs without basal spine. Fore basitarsi longer than the mid ones. Hind basitarsi about 1/3 shorter than hind tibiae. Second tarsomere of hind legs slightly shorter than the fourth. Pretarsal claws simple. Arolia present.

Sculpture. Head, mesosoma, petiole and postpetiole granulate (Fig. 117). First gastral tergite smooth and covered by sparse piligerous punctures; the punctures denser and more marked on the posterior border and on the sides. Legs granulate, the granulation less marked than on the other body parts.

Body covered by hairs of two main types: (1) short, dense, subdecumbent on the whole body; (2) shorter than hair type (1), dense and subdecumbent on the funicular joints. In addition the funicular joints bear whitish, thick, appressed, sparse hairs.

Colour. Brown or dark brown.

Measurements in mm and Indices: TL 2.92-3.39; HL 0.65-0.76; HW 0.60-0.68; EL 0.03-0.04; SL 0.41-0.48; WL 0.80-0.92; PeL 0.25-0.30; PeW 0.25-0.32; HFeL 0.52-0.56; HTiL 0.43-0.47; HBaL 0.28-0.32; LS4 0.21-0.26; LT4 0.63-0.83; CI 89.3-93.0; SI 61.1-63.1; IGR 0.31-0.34.

MATERIAL EXAMINED: BHUTAN: Phuntsholing, 200-400 m, 15.IV.1972, 3 workers (holotype and paratypes), Naturhistorisches Museum Basel – Bhutan Expedition [NHMB, MRSN]. INDIA: DARJEELING, Jhepi, 1300-1400 m, 17.V.1975, 1 worker, W. Wittmer [NHMB]. UTTAR PRADESH: Kumaon, Kathgodam near Haldwani, 600 m, 6.X.1979, 1 worker, I. Löbl [MHNG]; Kuamun District, Bhim Tal, near 1500 m, sifted litter, secondary forest, dry easter slope, 4.X.1979, 1 worker, I. Löbl [ANIC]; Garhwal District, 22 km N Rishikesh, 450 m, litter, 30.X.1979, 1 worker, I. Löbl [ANIC]. MEGHALAYA: Khasi Hills, Shillong, 28.IV.1978, 1 worker, R. Mathew [BMNH].

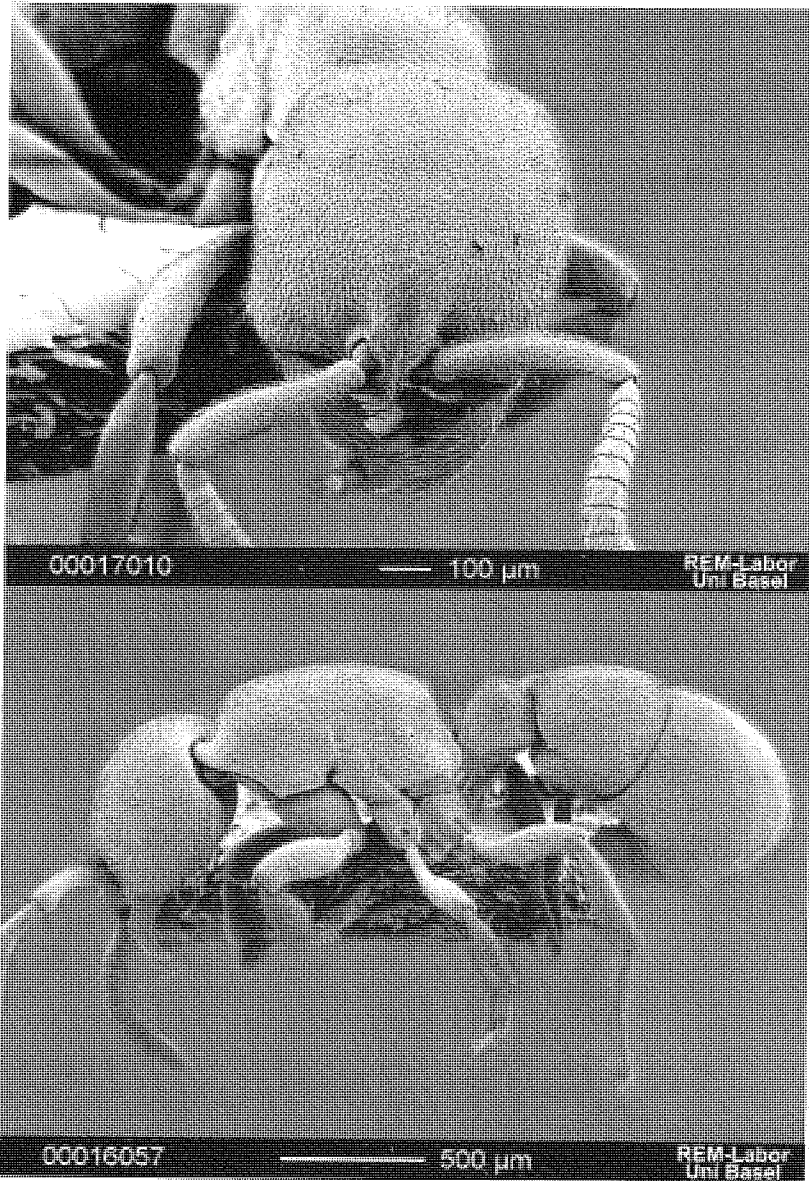


Fig. 116 – *Proceratium bhutanense* de Andrade. Worker (paratype) from Phuntsholing, Bhutan: head (top) in dorsal view and meso- and metasoma (bottom) in side view.



DISCUSSION. *P. bhutanense* emerges from our analysis as the sister species of *malesianum*. Its main autapomorphy, the absence of erect hairs, is shared homoplastically only with the far relatives *californicum*, from the United States and *terrioni* from Cameroon.

The worker from the Khasi Hills differs from the other workers examined by the first gastral tergite entirely covered by distinct punctures. The worker from Kuamun differs from the others by its longer gaster. Only the collection of additional material may prove that these differences are worthy of specific separation within what we presently regard as a single, variable *bhutanense*.

DISTRIBUTION: South Bhutan and North India.

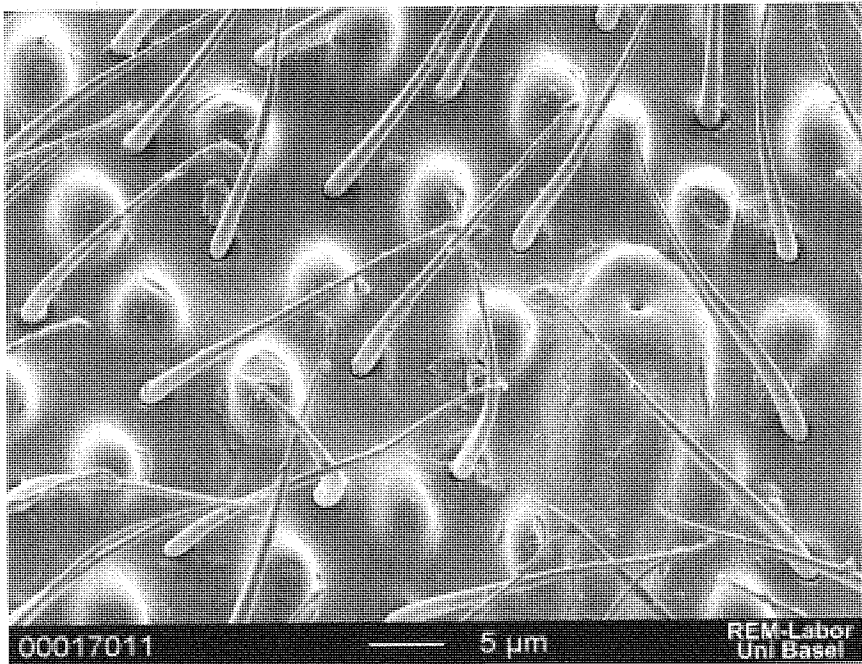


Fig. 117 – *Proceratium bhutanense* de Andrade. Worker (paratype) from Phuntsholing, Bhutan: sculpture of the head.

## THE *TOSCHII* CLADE

This clade includes two species only: *toschii* and *terrioni*, both from the African tropics. *Toschii* and *terrioni* share the blunt propodeal spines and the frontal carinae very close to each other and posteriorly fused. Another character shared by these two species is the first gastral sternite strongly protruding anteriorly. This character is not specifically considered in our cladistic analysis because it appears in an unpredictable way among the other species of the genus.

### ***Proceratium toschii*** (Consani)

Fig. 118

*Sysphincta toschii* Consani, 1951: 167, fig. 1. "Worker". Original description. Type locality: Nairobi, Kenya. Type material: holotype sub-ergatoid gyne labelled: "Kenia, Nairobi, IX-45, S. Patrizi leg., *Sysphincta toschii* Cons., 1949 det. M. Consani" in DIVA, examined.

*Proceratium toschii* Consani, Brown, 1958: 248. First combination in *Proceratium*.

**DIAGNOSIS.** A *Proceratium* species belonging to the *toschii* clade and differing from its sister species, *terrioni*, in the worker, by the presence of suberect, long hairs on the head and on the mesosoma.

**DESCRIPTION.** *Sub-ergatoid gyne* (Fig. 118). The sole known specimen exhibits a regular worker morphology coupled with the presence of large eyes and of the anterior ocellus. Head slightly longer than broad, with the sides weakly diverging posteriorly. Vertex convex. Clypeus medially reduced, subconvex, with superficially crenulate margin and about as long as the antennal socket. Antennal socket with broad torulus. Frontal carinae raised, very close each other on the two anterior thirds weakly diverging posteriorly and on the last third connected each other and almost perpendicular to the cephalic capsule. Lateral expansions of the frontal carinae narrow. Genal carinae absent. Gular area not impressed. Eyes relatively large, with ca. 25 ommatidia and below the midline of the head. Anterior ocellus present and developed. First funicular joint 1/5 longer than broad. Funicular joints 2-10 broader than long. Last funicular joint about as long as the sum of joints 7-10. Scapes much short of the vertexal margin and gently thicken-

ing apically. Masticatory margin of the mandibles with 3-4 denticles before the pointed apical tooth. Palp formula not visible in the sole known specimen.

Mesosoma about as long as the maximum head length (mandibles included), convex dorsally. Propodeal suture superficially impressed dorsally. Promesopleural and meso-metapleural sutures impressed ventrally only. Basal face of the propodeum gently declivous posteriorly. Area between the basal and declivous faces with a relatively large, blunt tooth on each side. Propodeal lobes subround. Propodeal spiracle small, round and placed above mid height of the propodeum in lateral view. Metapleural gland with inflated and transparent bulla.

Petiole with weakly cuneiform apex in profile broader than long, in dorsal view; its sides shortly diverging anteriorly and convex posteriorly. Anterior border of the petiole concave and marginate, the margin toothed on each side. Ventral process of the petiole lamelliform and subrectangular. Postpetiole in dorsal view broader than the petiole and with posteriorly diverging sides. Postpetiolar sternite anteromedially with a marked subconvex projection. Posterior half of the postpetiolar sternite convex. Constriction between postpetiole and gaster impressed. Gastral tergite I strongly convex and about 1/4 longer than the postpetiole. Gastral sternite I subround and projecting anteriorly. Remaining gastral tergites and sternites curved ventrally.

Legs slender but not very elongate. All tibiae with a pectinate spur. Spurs of fore legs without basal spine. Fore basitarsi longer than the mid ones. Hind basitarsi about 1/5 shorter than hind tibiae. Tarsomeres of mid and hind legs missing in the holotype. Pretarsal claws of fore legs simple. Arolium of fore legs developed.

Sculpture. Head, mesosoma and petiole granulate, the granulation more marked on the head. Postpetiole, gaster and legs smooth and with sparse, minute, superficial punctures.

Body covered by the following types of hairs (only the head and part of the mesosoma have well preserved hairs): (1) short, dense, suberect, on the head and mesosoma; (2) longer than type (1), suberect, rare on the head, on the mesosoma and on the scapes; (3) long, subdecumbent on the petiole, postpetiole and gaster; (4) shorter than hair type (1), dense, subdecumbent

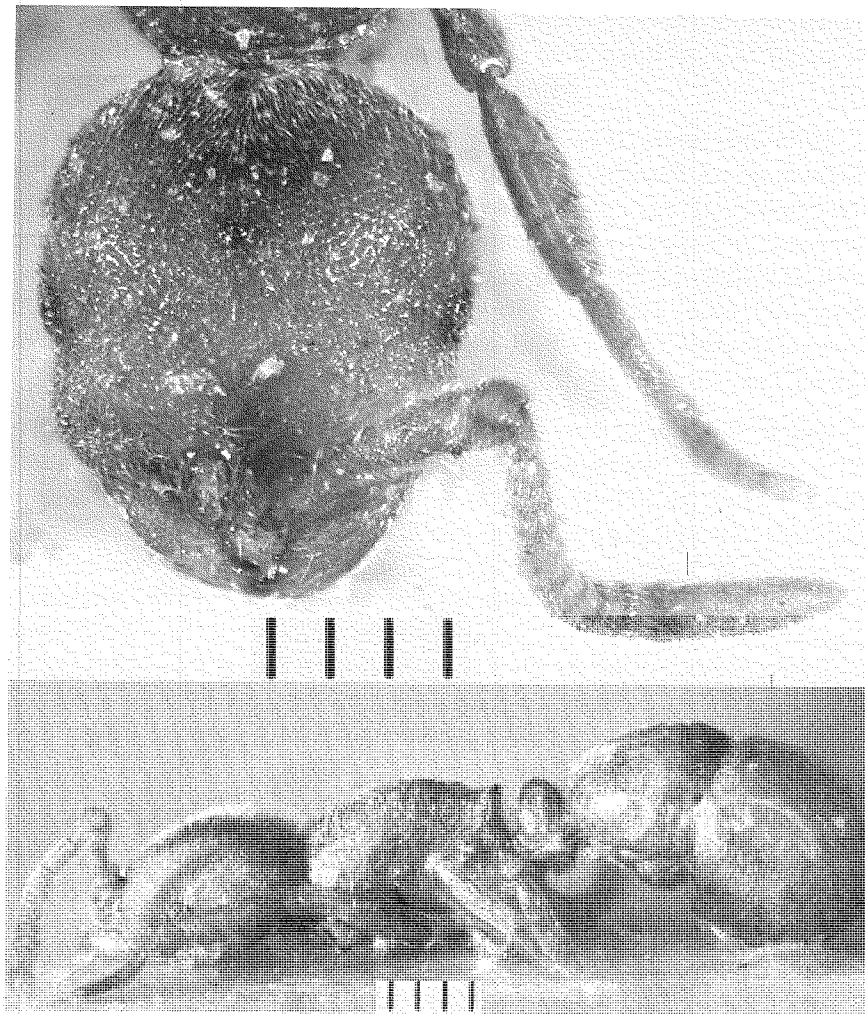


Fig. 118 – *Proceratium toschii* Consani. Sub-ergatoid gyne (holotype) from Nairobi, Kenya: head (top) in dorsal view and meso- and metasoma (bottom) in side view. Distance between two scale bars 0.1 mm.

and decumbent on the funicular joints. In addition the funicular joints bear whitish, thick, appressed, short, sparse hairs.

Colour light brown; area behind the ocelli darker.

Measurements in mm and Indices: TL 3.17; HL 0.77; HW 0.72; EL 0.10; SL 0.53; WL 0.88; PeL 0.25; PeW 0.28; HFeL 0.58; HTiL 0.48; HBaL 0.40; LS4 0.15; LT4 0.65; CI 93.5; SI 68.8; IGR 0.23.

MATERIAL EXAMINED: KENYA: Nairobi, IX.1945, 1 worker (holotype), S. Patrizi [DIVA].

DISCUSSION. *P. toschii* is the sister species of *terroni* to which it resembles in general body shape. In addition to the pilosity already mentioned in the respective diagnoses, the two species should differ also by the head shape, if the material we have been able to see is representative. The sole two specimens representing these two species known so far differ also for the presence of eyes in *toschii* (absent in *terroni*). Since the *toschii* holotype is likely to be a sub-ergatoid gyne, we don't attribute much importance to this character.

DISTRIBUTION: Kenya.

### ***Proceratium terroni* Bolton**

Figs. 119, 120

*Proceratium coecum* Terron, 1981: 91, fig. 2 worker. Worker. Original description. Type locality: Kala, Cameroon. Type material: worker labelled: "P. sp. 2 OL, Cameroun: Kala, 950 m, (18 km W Yaoundé), tamisage tissu ligneux en decomposition, 10.X.1972, G. Terron Leg., *Proceratium coecum* Terron, Holotype"; in CIRA, examined.

*Proceratium terroni* Bolton, 1995: 367. Replacement name for *P. coecum* Terron. Nec *Ponera caeca* Donisthorpe, 1949; junior synonym of *Proceratium papuanum* Emery (q. v.)

DIAGNOSIS. A *Proceratium* species belonging to the *toschii* clade and differing from its sister species *toschii*, in the worker, by the lack of suberect, long hairs on the head and on the mesosoma.

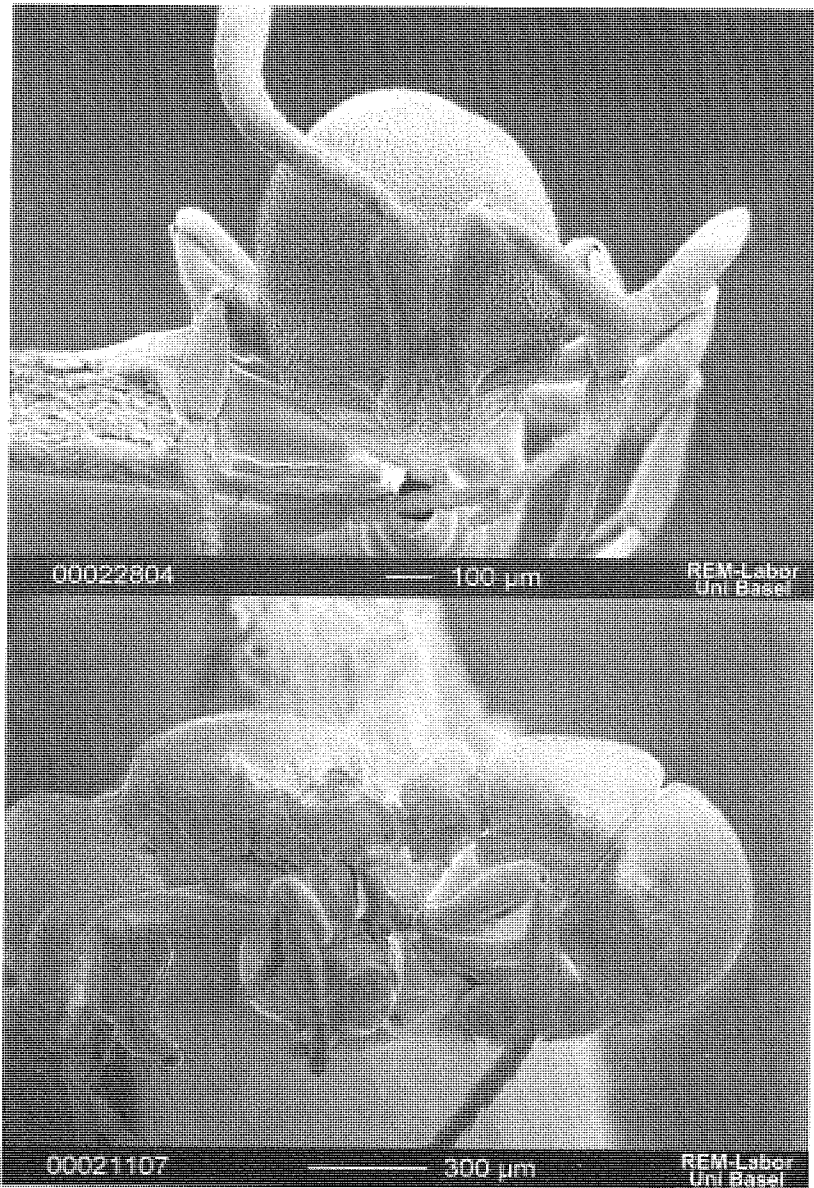


Fig. 119 – *Proceratium terroni* Bolton. Worker (holotype) from Kala, Cameroon: head (top) in dorsal view and meso- and metasoma (bottom) in side view.

DESCRIPTION. *Worker* (Figs. 119 & 120). Head longer than broad, with weakly convex sides gently converging into a strongly convex vertex. Clypeus medially reduced, subconvex, between the and about as long as the antennal sockets. Antennal socket with broad torulus. Frontal carinae raised, very close each other on the two anterior thirds gently convex and connected each other and almost perpendicular to the head capsule on the last third. Lateral expansions of the frontal carinae narrow. Anterolateral area close to the antennal insertions impressed. Genal carina absent. Gular area not impressed. Eyes absent. First funicular joint slightly longer than broad. Funicular joints 2-10 much broader than long. Last funicular joint about as long as the sum of joints 7-10. Scapes much short of the vertexal margin and gently thickening apically. External border of the mandibles flat. Masticatory margin of the mandibles with 3 denticles before the pointed apical tooth. Palp formula 3,2.

Mesosoma gently convex and shorter than maximum head length (mandibles included) in profile. Promesopleural and meso-metapleural sutures impressed ventrally only. Basal face of the propodeum gently declivous posteriorly. Area between the basal and declivous faces of the propodeum gently concave medially and with a blunt tooth on each side. Propodeal lobes subround. Propodeal spiracle round and above the mid height in lateral view. Metapleural gland bulla inflated and transparent.

Petiole with the anterior half sloping anteriorly and with the posterior half convex in profile, broader than long in dorsal view; its sides anteriorly shortly diverging and posteriorly convex. Anterior border of the petiole V-shaped and marginate. Ventral process of the petiole lamelliform, subrectangular with concave ventral margin. Postpetiole in dorsal view with the anterior border slightly broader than the petiole; its sides gently diverging posteriorly. Postpetiolar sternite anteromedially with a large subconvex projection. Posterior half of the postpetiolar sternite convex. Constriction between postpetiole and gaster impressed. Gastral tergite I strongly convex and slightly longer than the postpetiole. Gastral sternite I subround and strongly projecting anteriorly. Remaining gastral tergites and sternites curved ventrally.

Legs slender and slightly elongate. All tibiae with a pectinate spur. Spurs of fore legs without basal spine. Fore basitarsi longer than the mid ones.

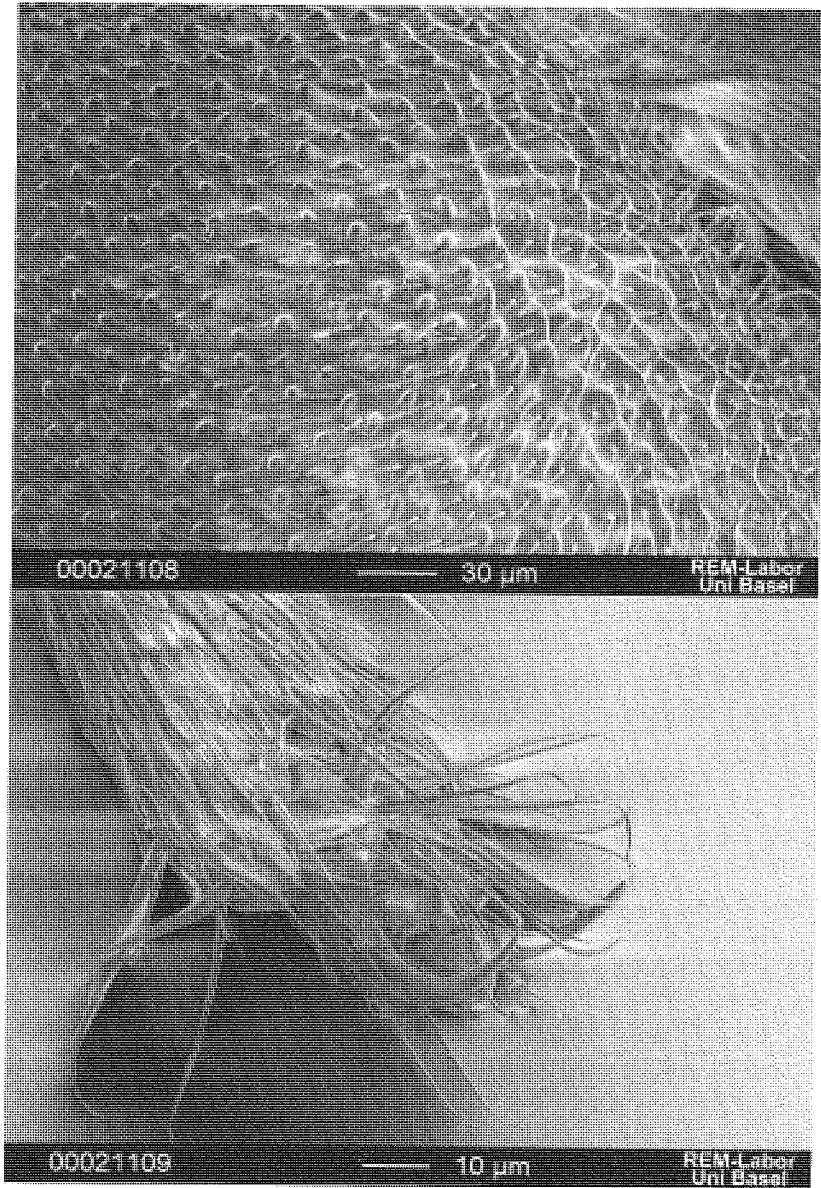


Fig. 120 – *Proceratium terroni* Bolton. Worker (holotype) from Kala, Cameroon: magnification of the cephalic sculpture (top) and arolium of the fore leg (bottom).



Hind basitarsi 1/5 shorter than hind tibiae. Second tarsomere of hind legs subequal in size to the pretarsus. Pretarsal claws simple. Arolia developed.

Sculpture. Head, mesosoma and petiole granulate, the granulation strongly marked on the head and on the mesosoma, superficial on the petiole. Postpetiole, gaster and legs smooth and with sparse, minute, superficial, piligerous punctures.

Body covered by hairs of three main types: (1) short, dense, decumbent on the whole body, absent from the posterior half of the metapleurae, on the postero-lateral sides of the petiole and on the postpetiolar sternite; (2) longer than type (1), subdecumbent and restricted only on the posterior half of the metapleurae, on the postero-lateral sides of the petiole and on the postpetiolar sternite; (3) shorter than hair type (1), dense, subdecumbent and decumbent on the funicular joints. In addition the funicular joints bear whitish, thick, appressed, short, sparse hairs.

Colour light brown.

Measurements in mm and Indices: TL 2.53; HL 0.69; HW 0.61; EL absent; SL 0.46; WL 0.70; PeL 0.21; PeW 0.25; HFel 0.48; HTiL 0.38; HBaL 0.27; LS4 0.12; LT4 0.44; CI 88.4; SI 66.7; IGR 0.27.

MATERIAL EXAMINED: CAMEROON: Kala, 18 km W Yaoundé, 950 m, tamisage tissus ligneux en decomposition, 10.X.1972, 1 worker (holotype), G. Terron [CIRA].

DISCUSSION. *P. terroni* is the sister species of *toschii* (q. v.). The discussion under the latter species contains the little which can be said about their presumed relationships. Another character not considered in our data matrix appears to stress the similarity between *toschii* and *terroni*: the shining postpetiole, a relatively rare trait appearing only among a few species of the *silaceum* clade.

DISTRIBUTION: Cameroon.

## THE *ARNOLDI* CLADE

This clade includes four species: *arnoldi*, *burundense*, *lunatum* and *galilaeum*. The first three species inhabit the African continent, while *P. galilaeum* is known from Israel only. The species belonging to this clade share a pair of transparent maculae on the vertexal angles and the presence of an often salient, transparent bulla on the posterior border of the postpetiole.

### *Proceratium lunatum* Terron

Fig. 121

*Proceratium lunatum* Terron, 1981: 96, fig. 1. Worker. Original description. Type locality: Mbalmayo, Kala and U. O. Bikok, Cameroon. Type material: holotype worker labelled: Cameroun: Arboretum de Mbalmayo (51 km D de Yaoundé), 17.III.1968, G. Terron leg., *Proceratium lunatum* Terron, Holotype, 1759 sp. 1", in CIRA; one paratype worker labelled: Cameroun: Kala (18 km W Yaoundé), Ve Berlèse, sp. 1, tamisage terre et terreau, 16.V.1974, G. Terron Leg., *Proceratium lunatum*, Paratype" in CIRA; two paratype workers labelled: "1759, Mbalmayo, Cameroun, 17.III.1968, Paratypus, *Proceratium lunatum*, G. Terron, 1981" in BMNH, MNHN; one paratype worker labelled: "UO Bikok, Cameroun, 19.III.1974, (G. Terron); Paratypus, *Proceratium lunatum* Terron", in MHNG, examined.

DIAGNOSIS. A *Proceratium* species belonging to the *arnoldi* clade and differing from its sister species, *burundense*, by the larger and deeper integumental foveae and by the deeper sculpture on the gaster in the worker.

DESCRIPTION. *Worker* (Fig. 121). Head slightly longer than broad, its sides gently diverging posteriorly. Vertex in full face view almost straight in the middle, in full dorsal view flat and bearing on each side a round, semi-transparent macula. Clypeus medially reduced, subconvex or almost straight, between and as long as or slightly longer than the antennal sockets. Anterior border of the clypeus minutely crenulate. Antennal socket with broad torulus. Frontal carinae slightly distant from each other, partially covering the antennal insertions. Frontal area concave posteriorly, the concavity connected to a longitudinal carina prolonging posteriorly. Lateral expansions of the frontal carinae narrow, slightly raised, diverging on the two an-

terior thirds and slightly converging on the posterior third. Genal carinae marked, each carina corresponding to the external border of a deep sulcus. Eyes small, recognisable as a dark dot below the integument and placed on the midline of the head. First funicular joint slightly longer than broad. Funicular joints 2-10 broader than long. Last funicular joint about as long as the sum of joints 7-10. Scapes much short of the vertexal margin and gently thickening apically. External border of the mandibles concave. Masticatory margin of the mandibles with 3 denticles before the pointed apical tooth. Palp formula 3,2.

Mesosoma convex in profile and as long as the maximum head length (mandibles included). Basal face of the propodeum gently declivous posteriorly. Area between the basal and declivous faces of the propodeum gently concave. Basal and declivous faces of the propodeum separate laterally by a lamellaceous tooth. Sides of the declivous face of the propodeum with a broader and obtuse posteriorly lamella. Lower mesopleurae with well defined sutures, their posterior half inflate and smooth. Propodeal spiracle round and above mid height in lateral view.

Petiolar node convex in profile, the dorsum of the node declivous posteriorly and bearing an irregular point postero-medially. Petiole in dorsal view with diverging sides on the anterior sixth and convex posteriorly. Anterior border of the petiole almost straight and carinate, the carina angulate on each side. Ventral process of the petiole lamellaceous, subrectangular, the lamella slightly pointed posteriorly. Postpetiole anteriorly broader than the petiole; its sides gently convex. Postpetiolar dorsum with a postero-medial, transparent, raised bulla below the integument. Postpetiolar sternite anteromedially with a marked subtriangular projection. Postpetiolar sternite in side view strongly convex posteriorly. Constriction between postpetiole and gaster impressed. Gastral tergite I convex on the curvature and with a postero-medial transparent, raised bulla below the integument. Remaining gastral tergites and sternites curved ventrally.

Legs slender but not very elongate. All tibiae with a pectinate spur. Spurs of fore legs without basal spine. Fore basitarsi longer than the mid ones. Hind basitarsi about 1/4 shorter than hind tibiae. First tarsomere of hind legs subequal in size to the pretarsus. Pretarsal claws simple. Arolia developed.

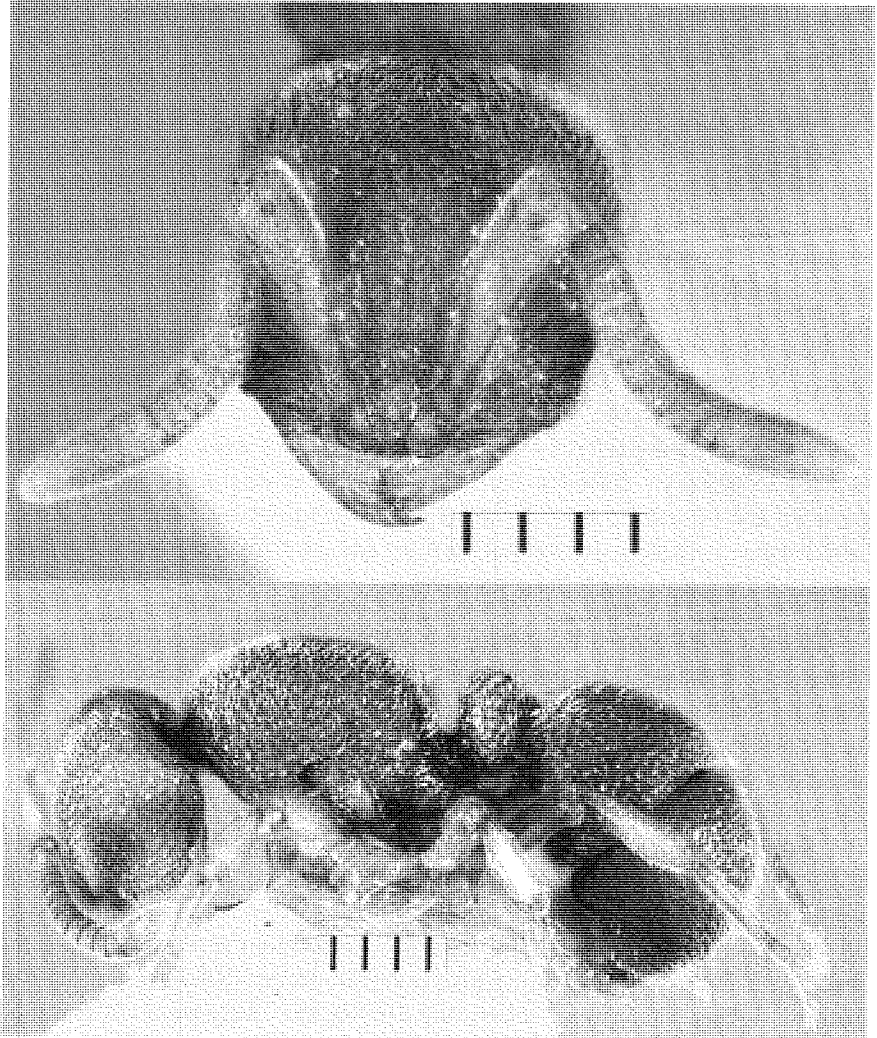


Fig. 121 – *Proceratium lunatum* Terron. Worker (paratype) from Mbalmayo, Cameroon: head (top) in dorsal view and meso- and metasoma (bottom) in side view. Distance between two scale bars 0.1 mm.

Sculpture. Head, mesosoma, petiole, postpetiole and gaster irregularly foveolate and granulate, the foveae slightly shallower and sparser on the head. Gaster with additional longitudinal, irregular, thin rugosities. Legs punctate.

Body covered by hairs of three main types: (1) short, dense, subdecumbent on the whole body, slightly shorter, sparse and suberect on the funicular joints; (2) longer than type (1), very sparse and subdecumbent on the whole body, rare and slightly shorter on the scapes, slightly denser, longer and more raised on the propodeum, on the petiole, on the postpetiolar sternite and on the femora; (3) shorter than hair type (1), dense and decumbent on the funicular joints only. In addition the funicular joints bear whitish, thick, appressed, short, sparse hairs.

Colour. Light ferruginous-brown with lighter antennae and legs.

Measurements in mm and Indices: TL 2.93-2.95; HL 0.71-0.73; HW 0.67-0.68; EL 0.03-0.04; SL 0.47-0.49; WL 0.85-0.86; PeL 0.28-0.29; PeW 0.34-0.36; HFeL 0.52-0.54; HTiL 0.44-0.45; HBaL 0.33; LS4 0.18-0.19; LT4 0.48-0.52; CI 93.0-94.4; SI 66.2-67.1; IGR 0.36-0.38.

MATERIAL EXAMINED: CAMEROON: Arboretum de Mbalmayo (51 km S de Yaoundé), 17.III.1968, 1 worker (holotype), G. Terron [CIRA]; Mbalmayo, 17.III.1968, 2 workers (paratypes), G. Terron [BMNH, MNHN]; Kala (18 km W Yaoundé), tamisage terre et terreau, 16.V.1974, 1 worker (paratype), G. Terron [CIRA]; UO Bikok, 19.III.1974, 1 worker (paratype), Berlesate, G. Terron [MHNG].

DISCUSSION. *P. lunatum* is the sister species of *burundense* with which it shares synapomorphically the foveolate sculpture of the gaster. The extent of this structure, however, represents the easiest way to distinguish the two species.

DISTRIBUTION: Cameroon.

**Proceratium burundense** de Andrade n. sp.

Fig. 122

TYPE MATERIAL: holotype worker (unique) from Burundi labelled: "Burundi, Bujumbura, 4.III.77, A. Dejean" in BMNH.

DERIVATIO NOMINIS: "*burundense*" is a neologism indicating the provenance from Burundi.

DIAGNOSIS. A *Proceratium* species belonging to the *arnoldi* clade and differing from its sister species, *lunatum*, in the worker, by the head more elongate and the scape longer and less robust, by the smaller and more superficial foveae over the whole integument and by the subtler sculpture on the gaster.

DESCRIPTION. *Worker* (Fig. 122). Head slightly longer than broad, its sides weakly convex. Vertex in full face view slightly convex, in full dorsal view flat and bearing on each side a round, semitransparent macula. Clypeus medially reduced, subconvex, between the and slightly longer than the antennal sockets. Anterior border of the clypeus minutely crenulate. Antennal socket with broad torulus. Frontal carinae far from each other, partially covering the antennal insertions. Frontal area concave posteriorly, the concavity connected to a longitudinal carina prolonging posteriorly. Lateral expansions of the frontal carinae broader than in *lunatum*, slightly raised, diverging on the two anterior thirds and slightly converging on the posterior third. Genal carinae marked, each carina corresponding to the external border of a deep sulcus. Eyes relatively large, composed by 9 ommatidia and placed on the midline of the head. First funicular joint slightly longer than broad. Funicular joints 2-10 broader than long. Last funicular joint about as long as the sum of joints 7-10. Scapes much shorter than the vertexal margin and gently thickening apically. External border of the mandibles concave. Masticatory margin of the mandibles with 3-4 denticles before the pointed apical tooth. Palp formula 3,2.

Mesosoma convex in profile and slightly longer than the maximum head length (mandibles included). Basal face of the propodeum gently declivous posteriorly. Area between the basal and declivous faces of the propodeum weakly concave. Basal and declivous faces of the propodeum separate laterally by a lamellaceous tooth. Sides of the declivous face of the propodeum

with a broader and posteriorly obtuse lamella. Lower mesopleurae with well defined sutures, their posterior half strongly inflate and smooth. Propodeal spiracle round and above mid height in lateral view.

Petiolar node subconvex in profile, the dorsum of the node almost flat and bearing an irregular point postero-medially. Petiole in dorsal view with the sides diverging on the anterior fifth and convex posteriorly; its anterior border almost straight, carinate and laterally denticulate. Ventral process of the petiole lamelliform, subrectangular, the lamella strongly pointed posteriorly. Postpetiole anteriorly broader than the petiole; its sides gently convex. Postpetiolar dorsum with a postero-medial, semitransparent, flat bulla below the integument. Postpetiolar sternite anteromedially with a marked subtriangular projection. Postpetiolar sternite strongly convex posteriorly in profile. Constriction between postpetiole and gaster impressed. Gastral tergite I convex on the curvature and with a postero-medial, semitransparent, flat bulla below the integument. Remaining gastral tergites and sternites curved ventrally.

Legs slender and more elongate than in *lunatum*. All tibiae with a pectinate spur. Spurs of fore legs without basal spine. Fore basitarsi longer than the mid ones. Hind basitarsi about 1/4 shorter than hind tibiae. First tarsomere of hind legs subequal in size to the pretarsus. Pretarsal claws simple. Arolia present.

Sculpture. Head, mesosoma, petiole, postpetiole and gaster with small, irregular foveae and granulate, the foveae smaller, shallower and sparser on the anterior third of the first gastral tergite. Gaster with additional longitudinal, irregular, thin rugosities on the posterior two thirds. Legs punctate.

Pilosity similar to *lunatum* but the hair type (1) suberect and subdecumbent and type (2) sparser.

Colour. Light ferruginous-brown with lighter legs.

Measurements in mm and Indices: TL 3.44; HL 0.79; HW 0.72; EL 0.06; SL 0.54; WL 1.02; PeL 0.33; PeL 0.33; PeW 0.38; HFeL 0.59; HTiL 0.51; HBaL 0.39; LS4 0.24; LT4 0.61; CI 91.1; SI 68.3; IGR 0.39.

MATERIAL EXAMINED: BURUNDI: Bujumbura, 4.III.1977, 1 worker (holotype), A. Dejean [BMNH].

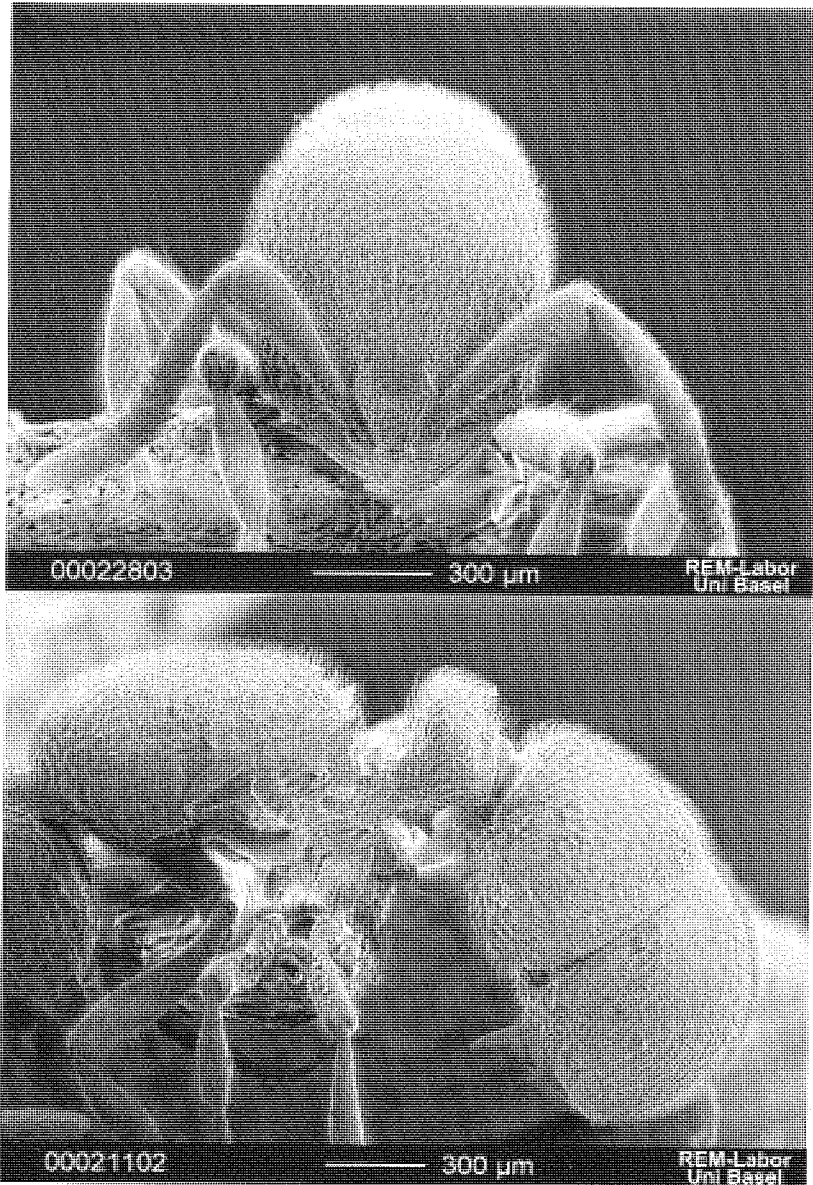


Fig. 122 – *Proceratium burundense* de Andrade. Worker (holotype) from Bujumbura, Burundi; head (top) in dorsal view and meso- and metasoma (bottom) in side view.



DISCUSSION. *Burundense*, known on one worker only, is the sole *Proceratium* species in which what we regard as a true worker has compound eyes. The sole worker of *P. toschii* also has well-developed eyes composed by 25 ommatidia but in this specimen the anterior ocellus is also well-developed. A true worker of *cubanum* has eyes consisting of a single convex facet as the other workers of the clade where it belongs. A second *cubanum* worker with well defined ommatidia, ocular pilosity and traces of ocelli is considered as sub-ergatoid in this paper (see the discussion under *convexiceps*).

DISTRIBUTION: Burundi.

### ***Proceratium arnoldi* Forel**

Fig. 123

*Proceratium (Sysphingta) Arnoldi* Forel, 1913: 210. Worker. Original description. Type locality: Bulawayo, Zimbabwe. Type material: holotype worker labelled: "Bulawayo (Arnold). *Sysphincta* Roger, sp. *Proceratium (Sysphincta) arnoldi* For., type" in MHNG, examined. A worker from Bulawayo, S. Rhodesia, 29.III.1913, G. Arnold, Arnold Coll. B.M.1934-354, labelled as syntype in BMNH is likely to be the specimen on which Arnold (1915) based his description and was probably never examined by Forel.

*Sysphincta Arnoldi* Forel, Arnold, 1915: 35. First combination in *Sysphincta*.

*Proceratium arnoldi* Forel, Brown, 1958a: 247. Figs. 1, 34-35 (worker).

DIAGNOSIS. A *Proceratium* species belonging to the *arnoldi* clade and resulting as outgroup of *lunatum* and *burundense*, and differing from both species, in the worker, by the sculpture more superficial and by the first gastral tergite more than 1/4 longer than the postpetiole instead of at least 1/7 of the length of the postpetiole.

DESCRIPTION. *Worker* (Fig. 123). Head longer than broad, with the sides gently diverging posteriorly. Vertex in full face view weakly convex. Clypeus medially reduced, gently convex, between the and slightly longer

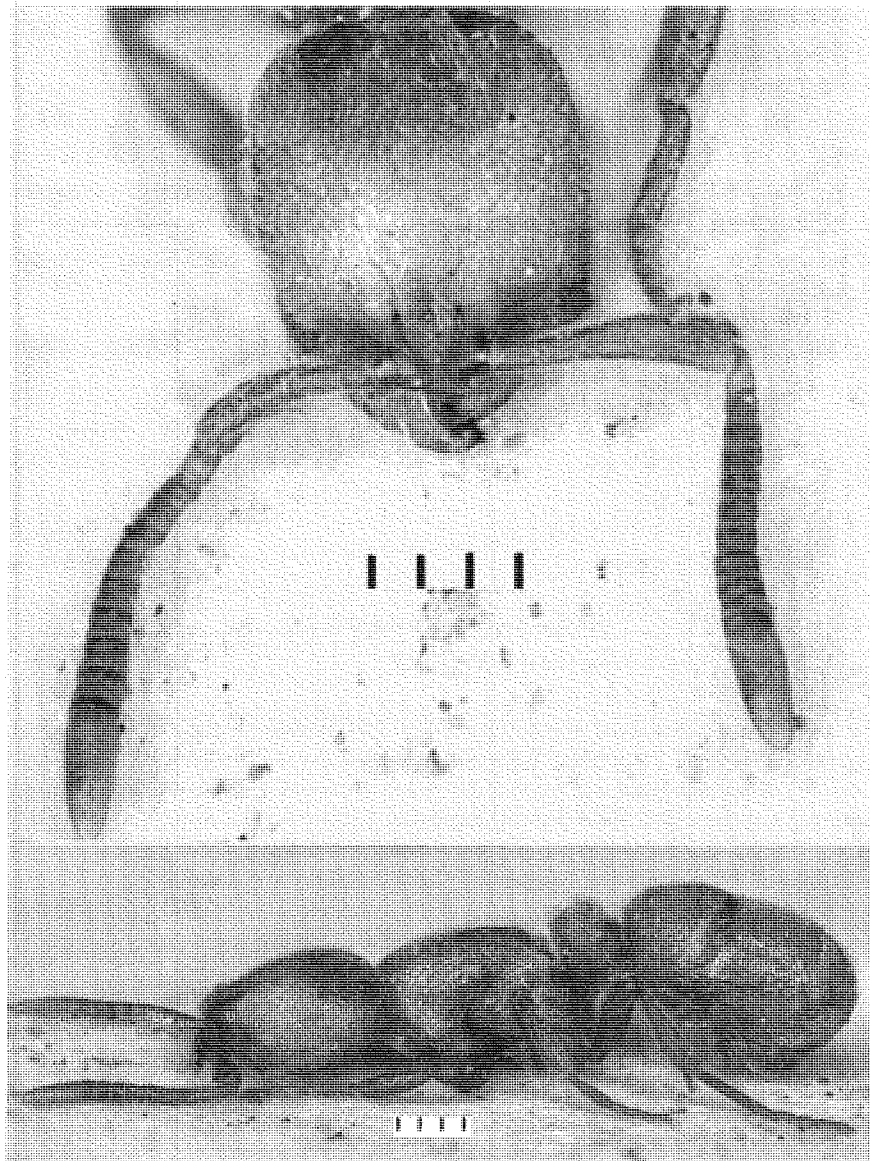


Fig. 123 – *Proceratium arnoldi* Forel. Worker from Bulawayo, Zimbabwe: head (top) in dorsal view and meso- and metasoma (bottom) in side view. Distance between two scale bars 0.1 mm.

than the antennal sockets. Anterior border of the clypeus gently convex. Antennal socket with broad torulus. Frontal carinae slightly far from each other, partially covering the antennal insertions. Frontal area concave on the posterior third. Lateral expansions of the frontal carinae narrow, raised, diverging on the two anterior thirds and subparallel on the posterior third. Genal carinae marked, each carina corresponding to the external border of a deep sulcus. Eyes small, visible as a dark dot below the integument. Eyes placed on the mid line of the head. First funicular joint  $1/4$  longer than broad. Funicular joints 2-10 broader than long. Scapes short of the vertexal margin and gently thickening apically. External border of the mandibles concave. Masticatory margin of the mandibles with 3 denticles before the pointed apical tooth. Palp formula 3,2.

Mesosoma gently convex in profile and as long as the maximum head length (mandibles included). Promesopleural and meso-metapleural sutures impressed ventrally only. Basal face of the propodeum declivous posteriorly. Declivous face of the propodeum gently concave anteriorly. Basal and declivous faces of the propodeum separate laterally by a lamelliform tooth. Sides of the declivous face of the propodeum with a broader and posteriorly subangulate lamella. Lower mesopleurae with well-defined sutures, its posterior half inflate and smooth. Propodeal spiracle round and above mid height in lateral view.

Petiolar node convex in profile, the dorsum of the node convex and bearing postero-medially a small, faint point. Petiole in dorsal view with the sides diverging on the anterior fifth and convex posteriorly. Anterior border of the petiole almost straight and carinate, the carina angulate on each side. Ventral process of the petiole lamelliform, subrectangular, pointed anteriorly and posteriorly. Postpetiole anteriorly broader than the petiole; its sides diverging posteriorly. Postpetiolar dorsum with a postero-medial, very faint, semitransparent, flat bulla below the integument. Postpetiolar sternite anteromedially with a marked subtriangular projection and strongly convex posteriorly in side view. Constriction between postpetiole and gaster impressed. Gastral tergite I convex on the curvature and with a postero-medial, very faint, semitransparent, flat bulla below the integument. Remaining gastral tergites and sternites curved ventrally.

Legs slender and slightly elongate. All tibiae with a pectinate spur. Spurs of fore legs without basal spine. Fore basitarsi longer than the mid ones. Hind basitarsi 1/4 shorter than hind tibiae. Second tarsomere of hind legs subequal in size to the pretarsus. Pretarsal claws simple. Arolia large.

Body covered by hairs of three main types: (1) short, dense, subdecumbent on the whole body, sparse and suberect on the funicular joints; (2) longer than type (1), sparse and subdecumbent on the whole body, slightly shorter and rare on the scapes, absent on the funiculi; (3) shorter than hair type (1), dense and decumbent on the funicular joints only. In addition the funicular joints bear whitish, thick, appressed, short, sparse hairs.

Sculpture. Head, mesosoma, petiole, postpetiole and gaster punctate and superficially foveolate, the punctures very sparse and superficial on the gaster which is slightly shining, the foveae shallower, smaller, sparser and more irregular on the head.

Colour. Light brown.

Measurements in mm and Indices: TL 3.24-3.29; HL 0.78-0.79; HW 0.68-0.69; EL 0.02-0.03; SL 0.51; WL 0.90-0.92; PeL 0.33-0.34; PeW 0.35; HFeL 0.57; HTiL 0.48-0.49; HBaL 0.36-0.37; LS4 0.25-0.26; LT4 0.66-0.67; CI 87.2-87.3; SI 64.5-65.4; IGR 0.38-0.39.

MATERIAL EXAMINED: ZIMBABWE: Bulawayo, 1 worker (holotype), Arnold [MHNG]; same locality, 29.III.1913, 1 worker (probably not a syn-type), Arnold [BMNH].

DISCUSSION. *P. arnoldi* results from our analysis as the outgroup of *lunatum* and *burundense*. *Arnoldi* also differs from *lunatum* and *burundense* by the smaller value of CI (87.2-87.3) instead of 91.1-94.4. *Arnoldi*, *lunatum* and *burundense* share the palp formula 3,2 and the lower mesopleurae shining and inflate. The shape of the head of *arnoldi* is more similar to the one of the outgroup species, *galilaeum*, than to *lunatum* and *burundense*.

DISTRIBUTION: Zimbabwe.

***Proceratium galilaeum*** de Andrade n. sp.  
Figs. 124, 125

*Proceratium arnoldi* Forel, Kugler, 1988: 256. Misidentification.

TYPE MATERIAL: holotype worker labelled: "ISRAEL, Galilée, Eilon, N. Betzet, 20.IV.1982, Besuchet, Löbl" in MHNG; 1 paratype worker same data and collection as the holotype.

DERIVATIO NOMINIS: "*galilaeus*" is an adjective indicating the provenance from Galilee.

DIAGNOSIS. A *Proceratium* species appearing as the basalmost of the *arnoldi* clade and differing from its ingroup species, *arnoldi*, in the worker, by the body sculpture more superficial, by the longer scapes, by the palp formula 4,3 instead of 3,2, and by the longer mid and hind basitarsi.

DESCRIPTION. *Worker* (Figs. 124 & 125). Head longer than broad and with subparallel sides. Vertex weakly convex in full face view and flat in full dorsal view. Clypeus medially reduced, superficially convex, between the and as long as the antennal sockets. Anterior border of the clypeus minutely crenulate. Antennal socket with broad torulus. Frontal carinae slightly far from each other, partially covering the antennal insertions. Frons gently concave medially and connected to a superficially marked longitudinal carina prolonging posteriorly. Lateral expansions of the frontal carinae narrow, raised, diverging on the two anterior thirds and subparallel on the posterior third. Genal carinae marked, each carina corresponding to the external border of a deep sulcus. Eyes small, visible as a dark dot below the integument over the mid line of the head. First funicular joint about 1/4 longer than broad. Funicular joints 2-10 broader than long. Last funicular joint about as long as the sum of joints 7-10. Scapes short of the vertexal margin and gently thickening apically. External base of the mandibles concave. Masticatory margin of the mandibles with 4 denticles before the pointed apical tooth. Palp formula 4,3.

Mesosoma gently convex in profile and slightly shorter than maximum head length (mandibles included). Promesopleural and meso-metapleural sutures impressed ventrally only. Basal face of the propodeum declivous posteriorly. Declivous face of the propodeum gently concave anteriorly. Basal and declivous faces of the propodeum separated laterally by a lamel-

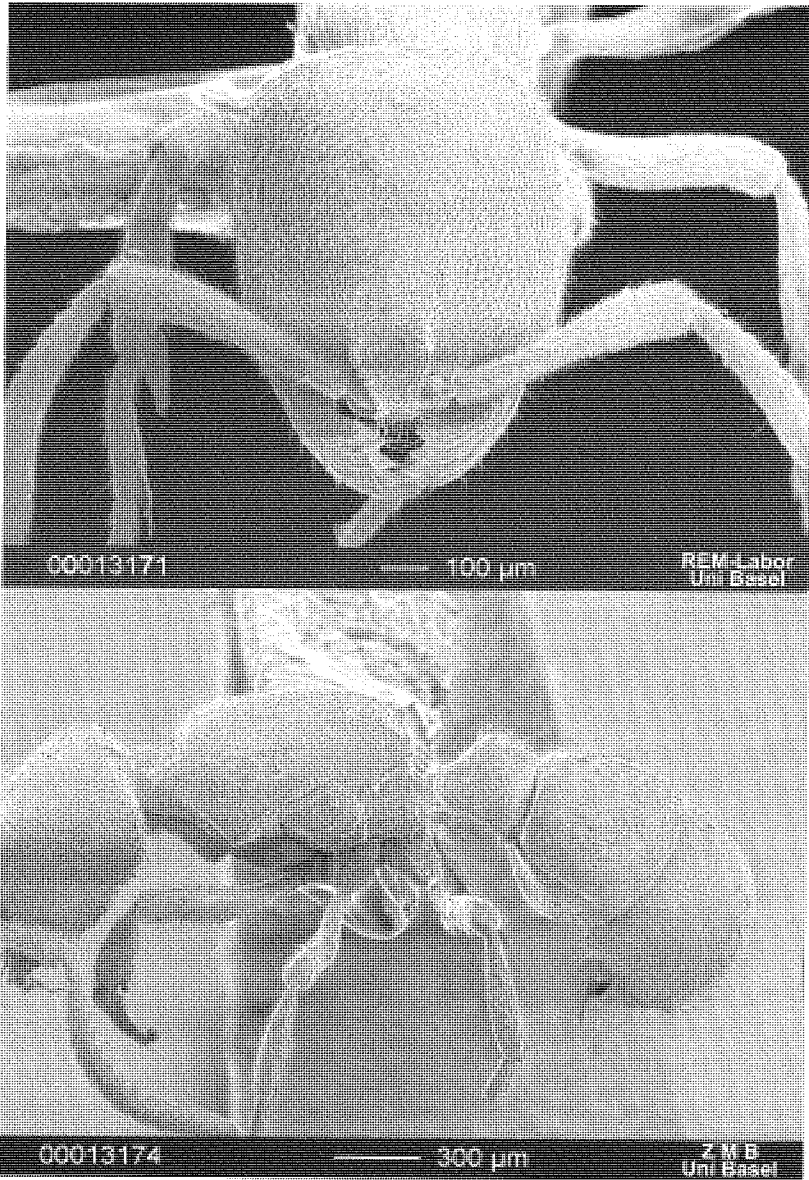


Fig. 124 – *Proceratium galilaeum* de Andrade. Worker (holotype) from Galilee, Israel: head (top) in dorsal view and meso- and metasoma (bottom) in side view.

lifiform tooth. Sides of the declivous face of the propodeum with a narrow lamella broader and subangulate posteriorly. Lower mesopleurae with well defined sutures and strongly inflat. Propodeal spiracle round and above mid height in lateral view.

Petiolar node subrectangular in profile, the dorsum of the node almost flat and bearing a postero-medial transparent, salient bulla below the integument. Petiole in dorsal view with its sides diverging on the anterior fourth and convex posteriorly. Anterior border of the petiole almost straight and carinate, the carina angulate on each side. Ventral process of the petiole lamelliform, rectangular, the lamella not pointed. Postpetiole anteriorly broader than the petiole; its sides diverging posteriorly. Postpetiolar dorsum with a postero-medial, transparent, salient bulla below the integument. Postpetiolar sternite anteromedially with a marked subtriangular projection. Postpetiolar sternite strongly convex posteriorly in profile. Constriction between postpetiole and gaster impressed. Gastral tergite II convex on the curvature and with a postero-medial, transparent, flat bulla below the integument. Remaining gastral tergites and sternites curved ventrally.

Legs slender and slightly elongate. All tibiae with a pectinate spur. Spurs of fore legs without basal spine. Fore basitarsi longer than the mid ones. Hind basitarsi 1/5 shorter than hind tibiae. Second tarsomere of hind legs subequal in size to the pretarsus. Pretarsal claws simple. Arolia present.

Sculpture. Head granulopunctate. Mesosoma and petiole granulopunctate and with traces of very sparse and superficial, irregular, foveae-like depressions. Postpetiole, gaster and legs minutely punctate.

Body covered by hairs of three main types: (1) short, dense, subdecumbent on the whole body, sparse and erect on the funicular joints; (2) longer than type (1), sparse and subdecumbent on the whole body, slightly shorter on the scapes, absent on the funiculi; (3) shorter than hair type (1), dense and decumbent on the funicular joints only. In addition the funicular joints bear whitish, thick, appressed, short, sparse hairs.

Colour. Light brown.

Measurements in mm and Indices: TL 3.11-3.40; HL 0.76-0.79; HW 0.66-0.69; EL 0.03-0.05; SL 0.53-0.55; WL 0.87-0.95; PeL 0.32-0.34; PeW 0.30-0.34; HTiL 0.51-0.54; HBaL 0.41-0.44; LS4 0.25-0.30; LT4 0.59-0.69; CI 86.8-87.3; SI 69.6-69.7; IGR 0.42-0.43.

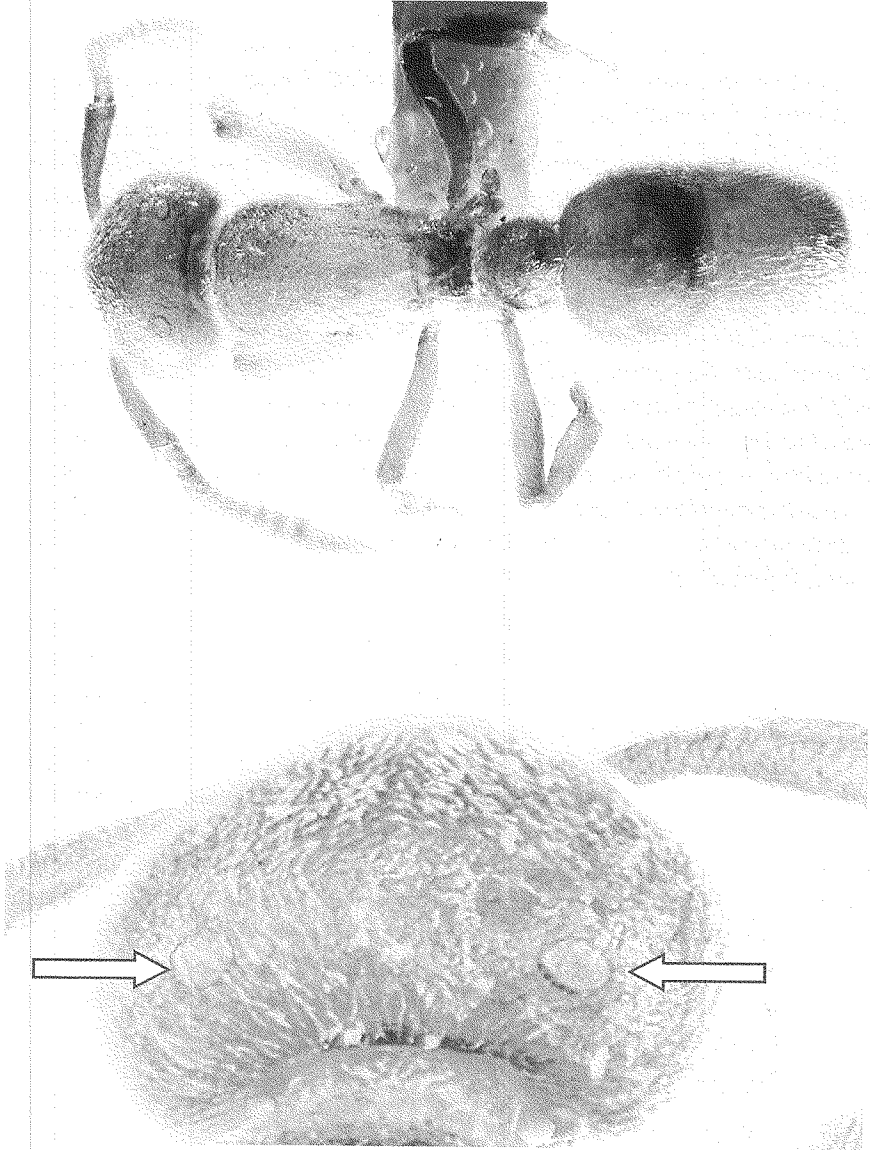


Fig. 125 – *Proceratium galilaeum* de Andrade. Worker (holotype) from Galilee, Israel: dorsal view (top) and detail of the head with the vertexal maculae shown by the arrows (bottom).



MATERIAL EXAMINED: ISRAEL: Galilee, Eilon, N of Betzet, 20.IV.1982, 2 workers (holotype and paratype), C. Besuchet & I. Löbl [MHNG].

DISCUSSION. *P. galilaeum* is the basalmost species of the *arnoldi* clade. It is easily recognisable by a clear, salient bulla on the posterior border of the petiole. It is easily distinguished from the other species of the clade by the less reduced palp formula (4,3 instead of 3,2) and by the lower mesopleurae entirely inflated. The description is based on the same specimens identified and published as *P. arnoldi* by Kugler (1988).

DISTRIBUTION: Israel.

## THE *SILACEUM* CLADE

This clade includes 30 species. The main synapomorphies of this clade are, for the worker and gyne: mandibular base with light macula, mid basitarsi with at least one hair 1/2 of the basitarsal length and arolia small or absent. Three other characters uniquely shared by the members of the *silaceum* clade are: worker and gyne: palp formula 2,2 and male palp formula 5,2 and clypeus anteriorly straight to weakly concave. These do not emerge as synapomorphic because of their equivocal ancestral state. Two species, *relictum* and *oceanicum*, both from the Fiji Islands, can be easily separated from the remaining 27 included in this clade by the petiole squamiform and with thin apex. They may constitute a small and homogeneous group within the clade: all the remaining species have a rectangular petiole and are much more difficult to characterize

The remaining 27 species of the *silaceum* clade are: *austronesicum*, *australe*, *angulinode*, *banjaranense*, *caledonicum*, *crassicorne*, *croceum*, *dayak*, *dusun*, *gigas*, *gracile*, *hirsutum*, *ivimka*, *japonicum*, *lombokense*, *mancum*, *numidicum*, *papuanum*, *politum*, *pumilio*, *robustum*, *siamense*, *silaceum*, *snellingi*, *striativenter*, *sulawense*, *terraealtae*. To these species one should add also an insufficiently known species, *longigaster* from Vietnam, that we were unable to examine for this study.

### ***Proceratium relictum* Mann**

Fig. 126

*Proceratium relictum* Mann, 1921: 413, fig. 3 (worker). Worker and gyne. Original description. Type locality: Somosomo, Fiji Islands. Type material: 1 worker and 7 gynes (syntypes) labelled: "Somo Somo, Fiji, W. M. Mann, *Proceratium relictum* Mann Cotypes", in USNM and MCZC, all examined.

DIAGNOSIS. A *Proceratium* species resembling *oceanicum* and differing from it in the worker, by the larger size (TL > 5.0 mm instead of < 3.7 mm) and by the SI > 76 instead of < 72.

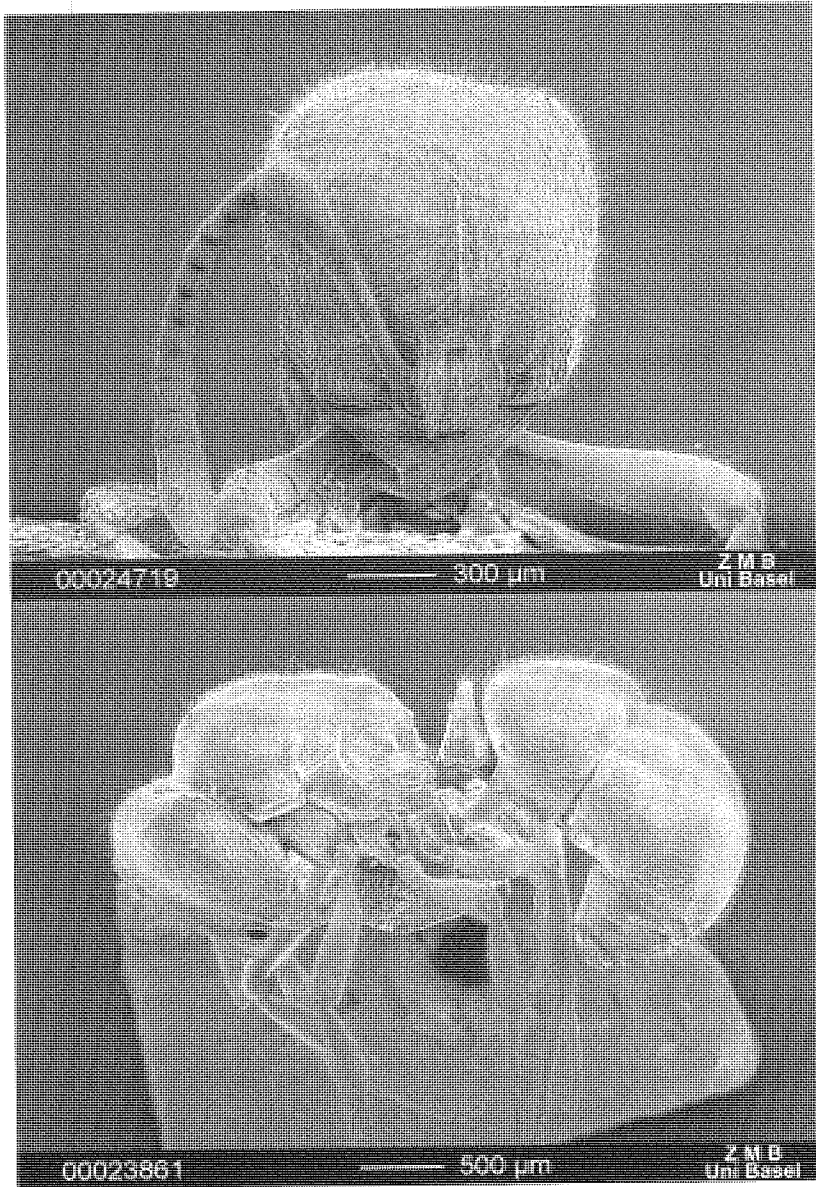


Fig. 126 – *Proceratium relictum* Mann. Worker (syntype) from Somosomo, Fiji Islands: head (top) in dorsal view and meso- and metasoma (bottom) in side view.

DESCRIPTION. *Worker* (Fig. 126). Head about as broad as long and with the sides gently diverging posteriorly. Vertex in full face view straight. Clypeus reduced and as long as the antennal sockets. Anterior border of the clypeus truncate. Frontal carinae far from each other, not covering the antennal insertions. Lateral expansions of the frontal carinae broad, moderately raised, diverging on the two anterior thirds and parallel and lower on the posterior third. Frontal area flat on the two anterior thirds, concave on the posterior third and with a long, thin longitudinal carina. Genal carinae marked, each carina corresponding to the external border of a deep sulcus. Eyes small and on the middle of the head sides. First funicular joint about  $1/5$  longer than broad. Funicular joints 2-10 slightly broader than long. Last funicular joint slightly longer than the sum of joints 7-10. Scapes short of the vertexal margin and gently thickening apically. Mandibles elongate. Masticatory margin of the mandibles with 7 denticles before the pointed apical tooth. Palp formula 2,2.

Mesosoma convex anteriorly, sloping posteriorly and slightly longer than the maximum head length (mandibles included) in profile. Pronotal suture very weakly impressed. Propodeal suture superficially impressed. Basal face of the propodeum slightly convex. Declivous face of the propodeum gently concave anteriorly and flat posteriorly. Each side of the declivous face of the propodeum carinate and with a small tooth after the concavity. Propodeal spiracle round and above mid height in lateral view.

Petiole squamiform, compressed and carinate dorsally. Anterior border of the petiole straight, without neck and carina. Ventral process of the petiole triangular and pointed. Postpetiole anteriorly slightly protruding on the petiole; its sides diverging and gently convex posteriorly. Postpetiolar sternite anteromedially with a marked subtriangular projection. Postpetiolar sternite gently convex posteriorly in profile. Constriction between postpetiole and gaster impressed. Gastral tergite I about  $1/3$  longer than the postpetiole and slightly convex on the curvature. Remaining gastral tergites and sternites curved ventrally.

Legs slender and slightly elongate. All tibiae with a pectinate spur. Spurs of fore legs without basal spine. Fore basitarsi longer than the mid ones. Hind basitarsi about  $1/10$  shorter than hind tibiae. Second tarsomere of hind legs subequal in size to the pretarsus. Pretarsal claws simple. Arolia small but present.

Sculpture. Body moderately shining. Head punctate and sparsely rugulose, the rugulae thicker and denser on the sides. Mesosoma, petiole, post-petiole, gaster and legs covered by dense, minute piligerous punctures.

Body covered by hairs of three main types: (1) short, dense, subdecumbent on the whole body, sparse on the funicular joints; (2) longer than type (1), erect on the whole body, sparse on the scapes, absent on the funiculi; (3) shorter than hair type (1), dense and decumbent on the funicular joints only. In addition the funicular joints bear whitish, thick, appressed, sparse hairs.

Colour. Dark reddish brown with lighter legs.

Measurements in mm and Indices: TL 5.09; HL 1.12; HW 1.10; EL 0.03; SL 0.87; WL 1.48; PeL 0.28; PeW 0.52; HFeL 1.10; HTiL 0.82; HBaL 0.74; LS4 0.54; LT4 1.12; CI 98.2; SI 77.7; IGR 0.48.

*Gyne*. Differing from the worker in the following details: eyes large, 1/5 of the head length, composed by many ommatidia and with ocular pilosity. Ocelli well developed. Funicular joints about as broad as long. Mesosoma robust and convex in side view. Parapsidal furrows weakly marked. Scutellum with the sides converging posteriorly and with the posterior border round. Metanotum with a minute denticle.

Measurements in mm and Indices: TL 5.78-5.91; HL 1.12-1.16; HW 1.14-1.16; EL 0.22; SL 0.90; WL 1.76-1.80; PeL 0.30-0.32; PeW 0.60; HTiL 0.85; HBaL 0.82-0.83; LS4 0.64-0.67; LT4 1.40; CI 100.0-101.8; SI 77.6-80.3; IGR 0.46-0.48.

MATERIAL EXAMINED: FIJI ISLANDS: Somosomo, 1 worker, 7 gynes (syntypes), Mann [USNM, MCZC].

DISCUSSION. *P. relictum* is a relatively large species easily recognizable by the characters already described above. It is known until now only on the type series.

DISTRIBUTION: Fiji Islands.

**Proceratium oceanicum** de Andrade n. sp.

Fig. 127

TYPE MATERIAL: holotype worker from Fiji Islands labelled: "Nadarivatu, Viti, Fiji, R. W. Taylor, 16.II.1962, on soil under grass, Rainforest, R. W. Taylor, acc 25", in ANIC.

DERIVATIO NOMINIS: *oceanicus* is a neologism created to indicate the provenance from Oceania.

DIAGNOSIS. A *Proceratium* species resembling *relictum* and differing from it, in the worker, by the smaller size (TL < 3.7 mm instead of > 5.0 mm) and by the SI < 72 instead of > 76.

DESCRIPTION. *Worker* (Fig. 127). Head slightly longer than broad and with the sides gently diverging posteriorly. Vertex in full face view gently convex. Clypeus reduced and as long as the antennal sockets. Anterior border of the clypeus truncate. Frontal carinae closer to each other than in *relictum*, not covering the antennal insertions. Lateral expansions of the frontal carinae narrower than in *relictum*, weakly raised, diverging on the two anterior thirds, parallel and lower on the posterior third. Frontal area flat and with a superficial, thin longitudinal carina. Head anterolaterally with a short, longitudinal carina. Genal carinae marked, each carina corresponding to the external border of a deep sulcus. Eyes visible as a dark dot below the integument, small and on the middle of the head sides. First funicular joint about 1/4 longer than broad. Funicular joints 2-10 broader than long. Last funicular joint as long as the sum of joints 7-10. Scapes short of the vertexal margin and gently thickening apically. Masticatory margin of the mandibles with 5 denticles before the pointed apical tooth. Palp formula 2,2.

Mesosoma in profile convex and about as long as the maximum head length (mandibles included). Pronotal and propodeal sutures absent. Basal face of the propodeum gently declivous posteriorly. Declivous face of the propodeum sloping posteriorly. Each side of the declivous face of the propodeum not carinate and with a trace of a minute, broad angle. Propodeal spiracle round and above mid height in lateral view.

Petiole squamiform, compressed and weakly carinate dorsally. Anterior border of the petiole straight, without neck and carina. Ventral process of

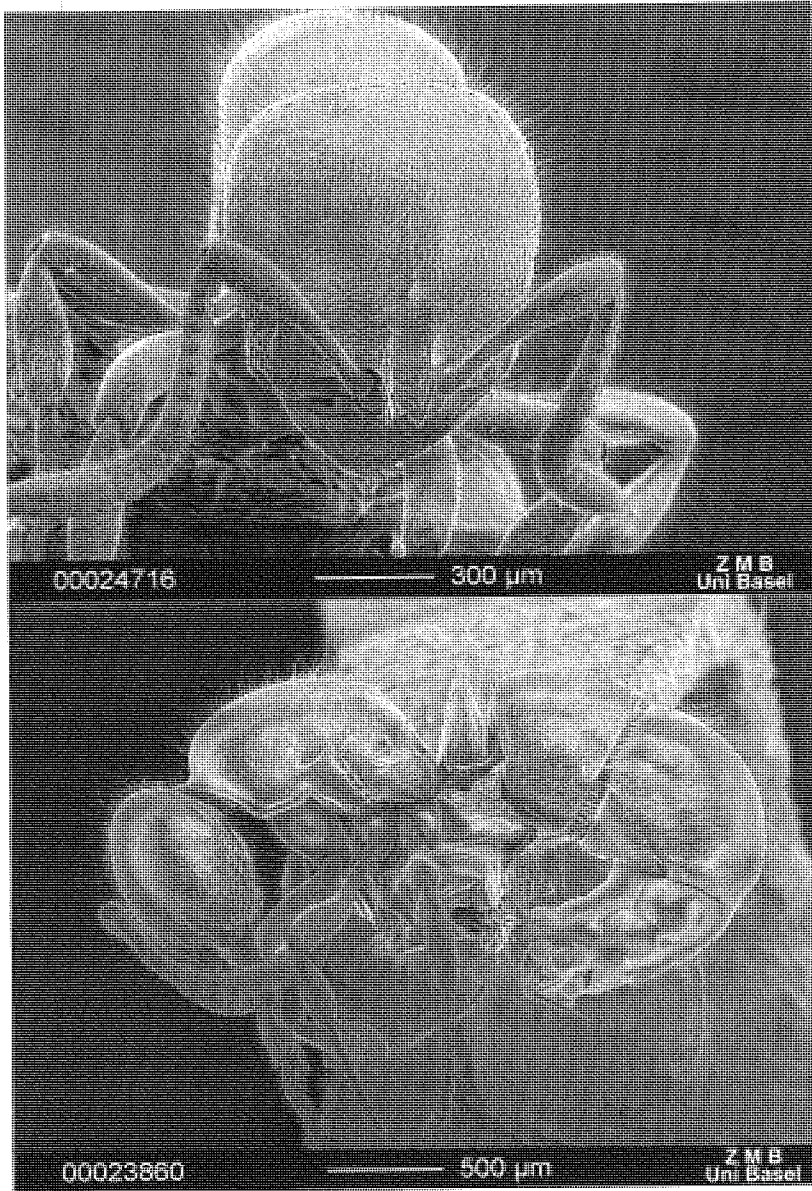


Fig. 127. – *Proceratium oceanicum* de Andrade. Worker from Nausori Highlands, Viti Levu, Fiji Islands: head (top) in dorsal view and meso- and metasoma (bottom) in side view.

the petiole small, stout and triangular. Postpetiole anteriorly slightly protruding over the petiole; its sides diverging and gently convex posteriorly. Postpetiolar sternite anteromedially with a marked subtriangular projection. Postpetiolar sternite gently convex posteriorly in profile. Constriction between postpetiole and gaster impressed. Gastral tergite I about 1/3 longer than the postpetiole and slightly convex on the curvature. Remaining gastral tergites and sternites curved ventrally.

Legs slender and slightly elongate. All tibiae with a pectinate spur. Spurs of fore legs without basal spine. Fore basitarsi longer than the mid ones. Hind basitarsi about 1/5 shorter than hind tibiae. Second tarsomere of hind legs shorter than pretarsus. Pretarsal claws simple. Arolia absent.

Sculpture. Body more shining than in *relictum*. Head covered with small piligerous punctures, the punctures denser, larger and mixed with irregular rugosities anterolaterally. Mesosoma, petiole postpetiole, gaster and legs covered by piligerous punctures smaller and sparser than on the posterior part of the head. Lower meso- and metapleurae with variably impressed, irregular, thin rugosities.

Body covered by hairs of three main types: (1) short, dense, suberect or subdecumbent on the whole body, suberect and sparse on the funicular joints; (2) longer than type (1), erect on the whole body, sparse on the scapes, absent on the funiculi; (3) shorter than hair type (1), dense and decumbent on the funicular joints only. In addition the funicular joints bear whitish, thick, appressed, sparse hairs.

Colour. Dark brown with lighter anterior half of the head. Legs dark orange to brown.

Measurements in mm and Indices: TL 3.47-3.59; HL 0.78-0.80; HW 0.75-0.78; EL 0.03-0.04; SL 0.54-0.56; WL 0.98-1.00; PeL 0.23-0.24; PeW 0.43-0.47; HFeL 0.63-0.65; HTiL 0.50-0.51; HBaL 0.39; LS4 0.39-0.40; LT4 0.76-0.80; CI 94.9-97.5; SI 68.3-71.8; IGR 0.50-0.52.

MATERIAL EXAMINED: FIJI ISLANDS: Viti Levu: Nadarivatu, 16.II.1962, on soil under grass, 1 worker (holotype), R. W. Taylor [ANIC]; Nausori Highlands, SW Fiji, 30.V-3.VI.1972, 1 worker, W. L. & D. E. Brown [MCZC]; Nausori Highlands, 600 m, 13.VII.1987, 1 worker, G. B. Monteith [ANIC].



DISCUSSION. *P. oceanicum* shares with *relictum* the squamiform petiole dorsally flattened. Few other species of the *silaceum* clade have a weakly squamiform petiole but, in this case, it is dorsally much less flattened than in *relictum* and *oceanicum*. Both species appear to be endemic of the Fiji Islands.

DISTRIBUTION: Fiji Islands.

***Proceratium austronesicum* de Andrade n. sp.**

Fig. 128

*Proceratium papuanum* Emery, Brown, 1958: 335. Misidentification.

TYPE MATERIAL: holotype worker from Papua New Guinea labelled: "PNG: Morobe, Wau, Mt. Kaindi, 25.V.92, 1800 m, G. Cuccodoro", in BMNH.

DERIVATIO NOMINIS: "*austronesicum*" is a neologism created by analogy with the common name of most indigenous languages spoken in Papua.

DIAGNOSIS. A *Proceratium* species belonging to the *silaceum* clade, resembling *dayak*, but differing from it, in the worker, by the smoother integument and by the shorter hind basitarsi.

DESCRIPTION. *Worker* (Fig. 128). Head about as broad as long and with the sides gently diverging posteriorly. Vertex in full face view almost straight. Clypeus reduced and as long as the antennal sockets. Anterior border of the clypeus truncate. Frontal carinae not very broad and not covering the antennal insertions. Lateral expansions of the frontal carinae narrow, weakly raised, diverging on the two anterior fourths, converging on the third fourth, parallel and carinate only on the last fourth. Frontal area gently concave and with a superficial, thin, longitudinal carina prolonging posteriorly. Head anterolaterally with a short, longitudinal carina. Genal carinae marked, each carina corresponding to the external border of a deep sulcus. Eyes visible as a dark dot below the integument, small and on the middle of

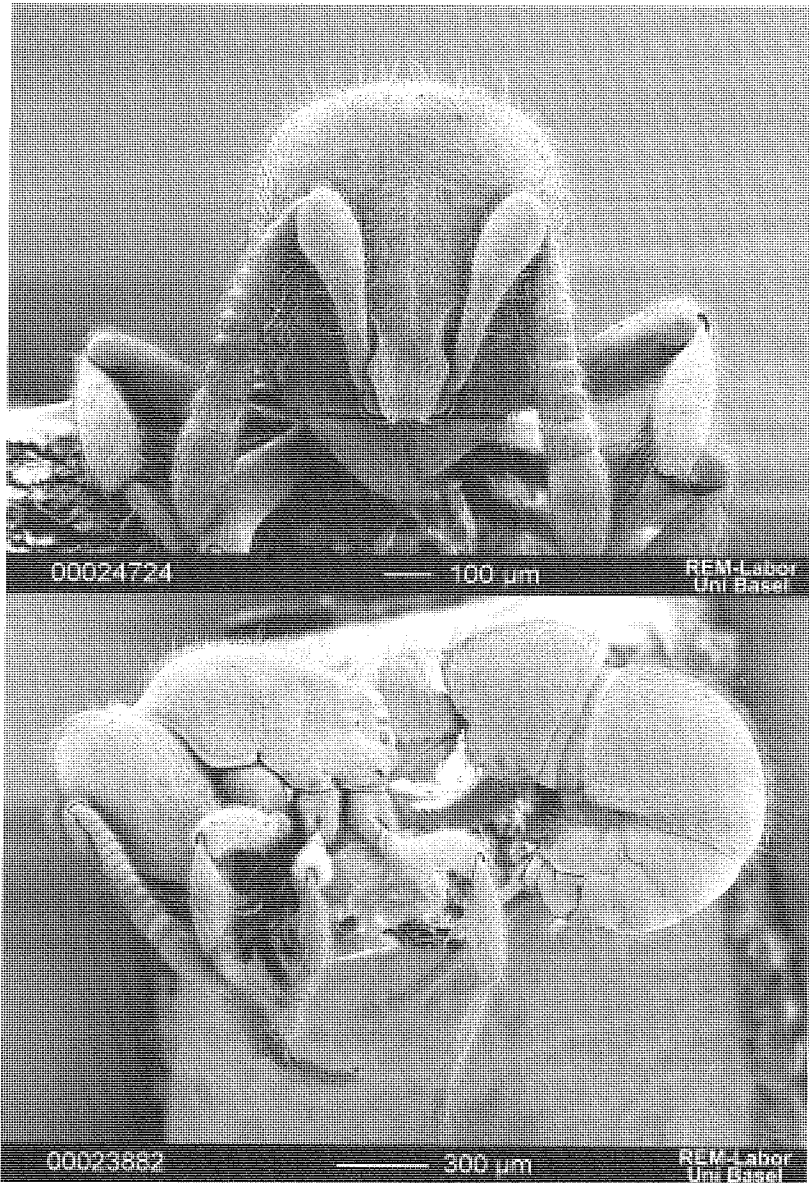


Fig. 128 – *Proceratium austronesicum* de Andrade. Worker from Kunai Creek, Wau, Papua New Guinea: head (top) in dorsal view and meso- and metasoma (bottom) in side view.

the head sides. First funicular joint about as broad as long. Funicular joints 2-10 broader than long. Last funicular joint as long as the sum of joints 6-10. Scapes short of the vertexal margin and gently thickening apically. Masticatory margin of the mandibles with 8 denticles before the pointed apical tooth. Palp formula 2,2.

Mesosoma in side view gently convex, slightly shorter or about as long as the maximum head length (mandibles included). Pronotal and propodeal sutures absent. Basal face of the propodeum declivous posteriorly. Area between the basal and declivous faces of the propodeum gently concave and with a triangular denticle on each side. Declivous face of the propodeum sloping posteriorly. Sides of the declivous face of the propodeum carinate. Propodeal spiracle round and above mid height in lateral view.

Petiole subrectangular and not very thick. Anterior border of the petiole straight and anterolaterally carinate. Ventral process of the petiole large, triangular and slightly pointed posteriorly. Postpetiole about 1/3 shorter than gastral tergite I. Postpetiole in dorsal view with convex sides. Postpetiolar sternite anteromedially with a marked subtriangular projection. Postpetiolar sternite in side view gently convex posteriorly. Constriction between postpetiole and gaster impressed. Gastral tergite I strongly convex on the curvature. Remaining gastral tergites and sternites curved ventrally.

Legs not very elongate. All tibiae with a pectinate spur. Spurs of fore legs without basal spine. Fore basitarsi longer than the mid ones. Hind basitarsi about 1/4 shorter than hind tibiae. Second tarsomere of hind legs shorter than pretarsus. Pretarsal claws simple. Arolia absent.

Sculpture. Body largely shining. Head, mesosoma, petiole, postpetiole and gaster covered by small piligerous punctures, the punctures denser on the head, very sparse on the center of the first gastral tergite. Area below the eyes and ventral part of the head reticulorugose. Legs minutely punctate.

Body covered by hairs of three main types: (1) short, dense, suberect or subdecumbent on the whole body, suberect and sparse on the funicular joints; (2) longer than type (1), erect on the whole body, sparse and slightly shorter on the scapes, absent on the funiculi; (3) shorter than hair type (1), dense and decumbent on the funicular joints only. In addition the funicular joints bear whitish, thick, appressed, sparse hairs.

Colour. Dark brown-black with lighter anterior third of the head, antennae and legs.

Measurements in mm and Indices: TL 2.70-3.15; HL 0.63-0.70; HW 0.61-0.69; EL 0.03-0.05; SL 0.41-0.46; WL 0.76-0.90; PeL 0.18-0.22; PeW 0.29-0.33; HFeL 0.46-0.52; HTiL 0.39-0.44; HBaL 0.28-0.35; LS4 0.28-0.35; LT4 0.58-0.70; CI 96.8-98.6; SI 64.1-65.7; IGR 0.48-0.51.

*Gyne*. Differing from the worker in the following details: eyes very large, about 1/4 of the head length, composed by many facets and with ocular pilosity. Ocelli well developed. Mesosoma robust and convex in side view. Parapsidal furrows marked. Scutellum with the sides converging posteriorly, with the posterior border round and dorsally with a median carina. Metanotum with a minute denticle.

Fore wings of our type 4, hind wings of our type 3 as defined in the description of the genus.

Measurements in mm and Indices: TL 3.30; HL 0.68; HW 0.67; EL 0.20; SL 0.46; WL 0.97; PeL 0.22; PeW 0.34; HFeL 0.54; HTiL 0.44; HBaL 0.34; LS4 0.37; LT4 0.74; CI 98.5; SI 67.6; IGR 0.50.

MATERIAL EXAMINED: PAPUA NEW GUINEA: Morobe, Wau, Mt. Kaindi, 1800 m, 25.V.1992, 1 worker (holotype), G. Cuccodoro [BMNH]; same locality, Mt. Kolorong, 2000 m, 3.VI.1992, 1 worker, G. Cuccodoro [BMNH]; Wau, 400 ft, 1.VII.1974, forest litter, 1 worker, Peck [MCZC]; Kunai Creek, SW of Wau, VI.1962, rainforest, ex rotten log, 16 workers, 1 gyne, R. W. Taylor [ANIC]; Wau, 16.VI.1962, 3 workers, B. B. Lowery [ANIC]; Tumnang, Mongi Watershed, Huon Peninsula, 1500 m, 14-15.IV.1955, 1 worker, E. O. Wilson [MCZC]; NE Mt. Missim, 5.XII.1979, 1 worker [LACM]. SOLOMON ISLANDS: San Cristobal, 29.VII.1965, in roots of arboreal fern, 1 gyne, PJM Greenslade [ANIC].

DISCUSSION. *P. austronesicum* seems to be relatively widespread in Papua New Guinea. It differs from the three other Papuan species of *Proceratium*, *ivimka*, *snellingi* and *papuanum* mainly by its larger size TL  $\geq$  2.70 mm instead of  $<$  2.60 mm. *Austronesicum* resembles also *dayak* from Sarawak with which it shares the narrow frontal carinae.

The workers of *austronesicum* from Mts. Missim and Kolorong differ from the other workers by the slightly thicker petiole and by the dark-red-

dish colour. Two of the three workers from Wau collected by B. B. Lowery are light brown instead of black and one worker is brown with some black maculae on different body parts. We assume that these are freshly moulted individuals.

Brown (1958a) considered the worker from Tumnang very similar to Emery's description of the gyne of *papuanum* and with the holotype worker of *Ponera caeca*. This Tumnang worker, however, is much larger (TL 2.79 mm, CI 96.8) than the workers of *papuanum* (TL 2.40-2.57 mm, CI 92.8-94.7) and than the holotype of *Ponera caeca* (TL 2.37 mm, CI 94.5). The frontal carinae of the Tumnang specimen are much narrower than in all the workers of *papuanum* and in the holotype of *caeca*. Except for the slightly paler colour, the Tumnang worker is identical to all other workers that we regard as *austronesicum*.

A large gyne (TL 3.81 mm, CI 97.5, SI 65.0, IGR 0.50) from the Solomon Islands (San Cristobal) is similar to the gyne of *austronesicum* from Kunai. We prefer to consider this specimen as *austronesicum* until the collection of more material may corroborate or contradict our attribution.

DISTRIBUTION: Papua New Guinea, ? Solomon Islands.

### ***Proceratium dayak*** de Andrade n. sp.

Fig. 129

TYPE MATERIAL: holotype worker from Sarawak labelled: "SARAWAK, 4<sup>th</sup> Divis. G. Mulu Expd. X.1977, Camp 5, H. Vallack, soil core", in BMNH.

DERIVATIO NOMINIS: Dayak is the name of one of the populations of Borneo. It is used as a name in apposition.

DIAGNOSIS. A *Proceratium* species belonging to the *silaceum* clade, resembling *austronesicum*, but differing from it, in the worker, by the body with denser and stronger punctures, and longer hind basitarsi.

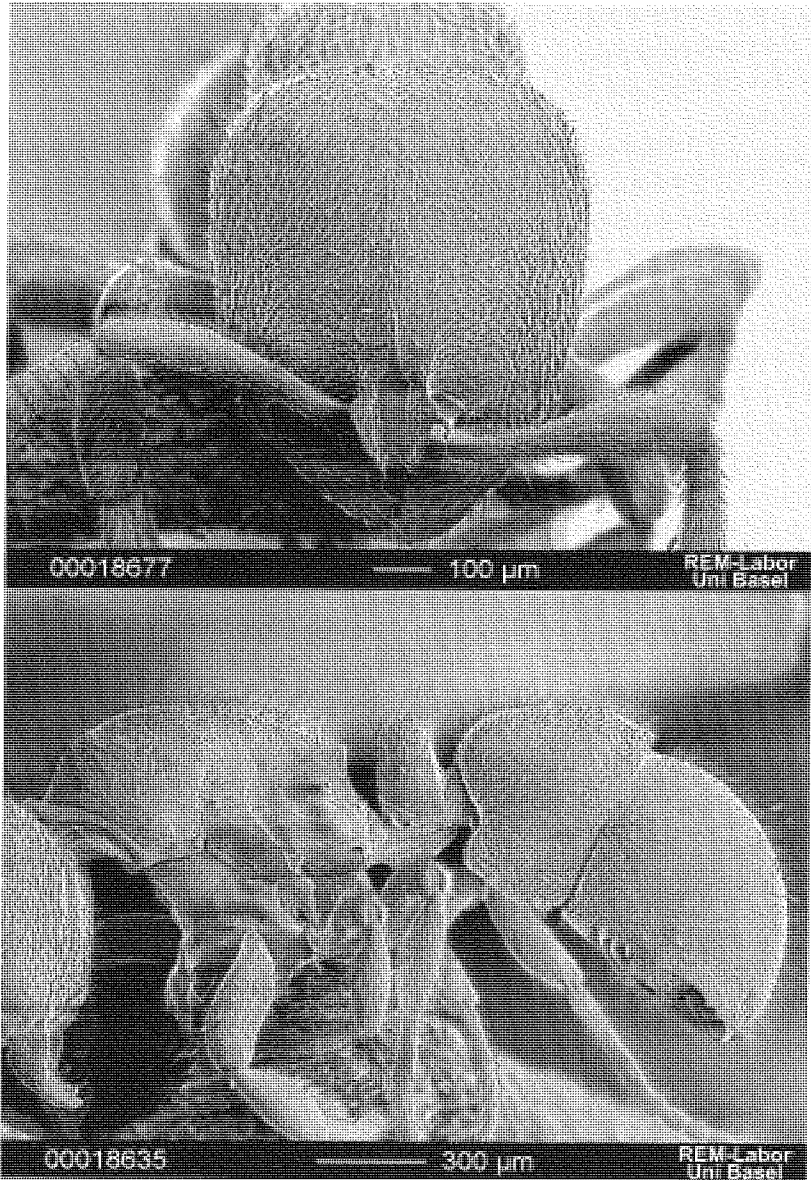


Fig. 129 – *Proceratium dayak* de Andrade. Worker (holotype) from 4<sup>th</sup> Division Gunung Mulu, Sarawak: head (top) in dorsal view and meso- and metasoma (bottom) in side view.

DESCRIPTION. *Worker* (Fig. 129). Head slightly longer than broad and with the sides gently diverging posteriorly. Vertex in full face view almost straight. Clypeus reduced and as long as the antennal sockets. Anterior border of the clypeus truncate. Frontal carinae not very broad, narrower than in *austronesicum* and not covering the antennal insertions. Lateral expansions of the frontal carinae narrow, weakly raised, diverging on the two anterior fourths, converging on the third fourth, subparallel and carinate only on the last fourth. Frontal area gently concave and with a superficial, thin longitudinal carina prolonging posteriorly. Head anterolaterally with a short, longitudinal carina. Genal carinae marked, each carina corresponding to the external border of a deep sulcus. Eyes absent. First funicular joint slightly longer than broad. Funicular joints 2-10 broader than long. Last funicular joint as long as the sum of joints 6-10. Scapes short of the vertexal margin and gently thickening apically. Masticatory margin of the mandibles with 6-7 denticles before the pointed apical tooth. Palp formula 2,2.

Mesosoma in side view gently convex, as long as the maximum head length (mandibles included). Pronotal and propodeal sutures absent. Basal face of the propodeum declivous posteriorly. Area between the basal and declivous faces of the propodeum gently concave and with a small triangular tooth on each side. Declivous face of the propodeum sloping posteriorly. Sides of the declivous face of the propodeum carinate. Propodeal spiracle round and above mid height in lateral view.

Petiole subrectangular. Anterior border of the petiole straight and anterolaterally carinate. Ventral process of the petiole large, triangular. Postpetiole about 1/3 shorter than gastral tergite I. Postpetiole in dorsal view with its sides diverging anteriorly and convex posteriorly. Postpetiolar sternite anteromedially with a marked subtriangular projection, gently convex posteriorly in profile. Constriction between postpetiole and gaster impressed. Gastral tergite I convex on the curvature. Remaining gastral tergites and sternites curved ventrally.

Legs not very elongate. All tibiae with a pectinate spur. Spurs of fore legs without basal spine. Fore basitarsi longer than the mid ones. Hind basitarsi about 1/5 shorter than hind tibiae. Second tarsomere of hind legs shorter than pretarsus. Pretarsal claws simple. Arolia absent.

Sculpture. Head, mesosoma, petiole and postpetiole densely punctate,

the punctures larger on the dorsum of the mesosoma, of the petiole and of the postpetiole. Areas below the eyes and ventral part of the head reticulogrose. Basal face of the propodeum with additional, thin, irregular rugulae. Gaster and legs minutely punctate.

Body covered by hairs of three main types: (1) short, dense, suberect or subdecumbent on the whole body, suberect and sparse on the funicular joints; (2) long and erect, but shorter than in *austronesicum*, on the whole body, sparser on the scapes, absent on the funiculi; (3) shorter than hair type (1), dense and decumbent on the funicular joints only. In addition the funicular joints bear whitish, thick, appressed, sparse hairs.

Colour. Dark ferruginous with slightly lighter legs.

Measurements in mm and Indices: TL 2.90; HL 0.68; HW 0.65; EL absent; SL 0.44; WL 0.83; PeL 0.21; PeW 0.32; HFeL 0.49; HTiL 0.39; HBaL 0.32; LS4 0.31; LT4 0.63; CI 95.6; SI 64.7; IGR 0.49.

MATERIAL EXAMINED: SARAWAK: 4<sup>th</sup> Division Gunung Mulu, X.1977, 1 worker (holotype), H. Vallack [BMNH].

DISCUSSION. *P. dayak* resembles *austronesicum* in many respects. The main differences between these two species are already mentioned under the respective diagnoses. In addition to the characters already cited, *dayak* also differs from *austronesicum* by the narrower frontal carinae.

DISTRIBUTION: Sarawak.

### ***Proceratium ivimka* de Andrade n. sp.**

Fig. 130

TYPE MATERIAL: holotype worker from Papua New Guinea labelled: "PNG. Gulf Prov.: Ivimka camp. Lakekamu Basin, 7.7°S 146.8°E 400 m el, 20 Nov. 1996, coll. R. R. Snelling # 96-350, lowland wet forest: sifted leaf litter & debris from rotten log"; 1 paratype worker labelled: "PNG. Gulf Prov.: Ivimka camp. Lakekamu Basin, 07.73°S 146.76°E 110 m, 14 Nov. 1996, R. R. Snelling # 96-325", both in LACM.



DERIVATIO NOMINIS: Ivimka is the name of the locality where the species was collected by Roy Snelling. It is used here as a specific name in apposition as suggested by Roy.

DIAGNOSIS. A *Proceratium* species belonging to the *silaceum* clade resembling *austronesicum* but differing from it, in the worker, by the smaller size ( $TL \leq 2.30$  mm instead of  $\geq 2.70$  mm), by the hairs of type (1) sparser on the gaster and by the first gastral tergite less convex.

DESCRIPTION. *Worker* (Fig. 130). Head slightly longer than broad and with the sides gently diverging posteriorly. Vertex in full face view weakly convex. Clypeus reduced and as long as the antennal sockets. Anterior border of the clypeus truncate. Frontal carinae not very broad, not covering the antennal insertions. Lateral expansions of the frontal carinae narrow, little raised, diverging on the two anterior fourths, converging on the third fourth, diverging and carinate only on the last fourth. Frontal area gently concave on the three anterior fourths and with a central, thick longitudinal carina starting from the last fourth and prolonging posteriorly. Head anterolaterally with a short, thin, longitudinal carina. Genal carinae marked, each carina corresponding to the external border of a deep sulcus. Eyes visible as a dark dot below the integument, small and on the middle of the head sides. First funicular joint slightly broader than long. Funicular joints 2-10 broader than long. Last funicular joint as long as the sum of joints 6-10. Scapes short of the vertexal margin and gently thickening apically. Masticatory margin of the mandibles with 7-8 denticles before the pointed apical tooth. Palp formula 2,2.

Mesosoma convex in profile and slightly shorter than maximum head length (mandibles included). Pronotal and propodeal sutures absent. Basal face of the propodeum declivous posteriorly. Declivous face of the propodeum gently sloping posteriorly. Sides between the basal and declivous faces of the propodeum minutely denticulate. Sides of the declivous face superficially carinate. Propodeal spiracle round and above mid height in lateral view.

Petiole subrectangular and flattened. Anterior border of the petiole straight and anterolaterally carinate. Ventral process of the petiole small and pointed backwards. Postpetiole in dorsal view with posteriorly diverging

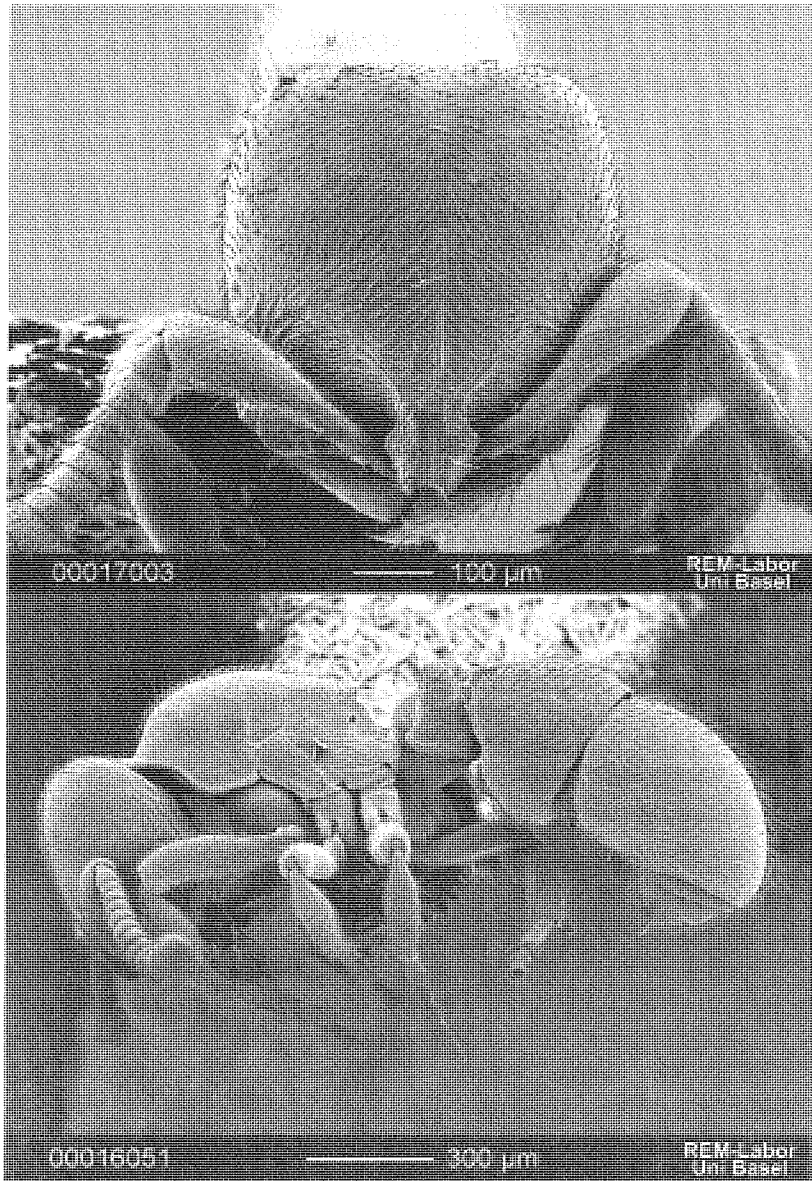


Fig. 130 – *Proceratium ivimka* de Andrade. Worker (paratype) from Gulf Province, Ivimka, Papua New Guinea: head (top) in dorsal view and meso- and metasoma (bottom) in side view.

sides. Postpetiolar sternite anteromedially with a marked subtriangular projection and gently convex posteriorly in side view. Constriction between postpetiole and gaster impressed. Gastral tergite I about 1/3 longer than the postpetiole and slightly convex on the curvature. Remaining gastral tergites and sternites curved ventrally.

Legs short. Fore tibiae incrassate. Mid and hind tibiae slightly incrassate. All tibiae with a pectinate spur. Spurs of forelegs without basal spine. Fore basitarsi longer than the mid ones. Hind basitarsi about 1/3 shorter than hind tibiae. Second tarsomere of hind legs shorter than pretarsus. Pretarsal claws simple. Arolia small but present.

Sculpture. Head minutely punctate; antero-dorsal and lateral parts of the head irregularly rugulose. Mesosoma, petiole, postpetiole and gaster punctate, the punctures absent from the posterodorsal part of the first gastral tergite which is smooth and with sparse piligerous punctures. Legs minutely punctate.

Body covered by hairs of three main types: (1) short, dense, subdecumbent on the whole body, sparser and slightly longer on the second gastral tergite, suberect and sparse on the funicular joints; (2) longer than type (1), erect on the whole body, absent from the antennae; (3) shorter than hair type (1), dense and decumbent on the funicular joints only. In addition the funicular joints bear whitish, thick, appressed, sparse hairs, and the scapes with sparse hairs similar to type (2) but slightly shorter.

Colour. Dark brown-black with lighter anterior half of the head dorsum, antennae and legs.

Measurements in mm and Indices: TL 2.20-2.30; HL 0.51-0.53; HW 0.48-0.50; EL 0.03; SL 0.34-0.35; WL 0.61-0.63; PeL 0.15-0.16; PeW 0.23-0.24; HFeL 0.34-0.35; HTiL 0.28-0.31; HBaL 0.20-0.21; LS4 0.24-0.25; LT4 0.47-0.51; CI 94.1-94.4; SI 64.8-66.7; IGR 0.49-0.51.

MATERIAL EXAMINED: PAPUA NEW GUINEA: Gulf Province: Ivimka camp. Lakekamu Basin, 7.7°S 146.8°E, 400 m elevation, 20.XI.1996, lowland wet forest: sifted leaf litter & debris from rotten log, 1 worker (holotype), R. R. Snelling [LACM]; same locality, 07.73°S 146.76°E, 110 m elevation, 14.XI.1996, 1 worker (paratype), R. R. Snelling [LACM].

DISCUSSION. *P. ivimka* resembles *austronesicum*, also from Papua New Guinea, for its superficial body sculpture and narrow frontal carinae but it differs from *austronesicum* by its smaller size (TL  $\leq$  2.30 mm instead of  $\geq$  2.70 mm) and by the other characters already given in the diagnosis.

DISTRIBUTION: Papua New Guinea.

***Proceratium politum*** de Andrade n. sp.

Fig. 131

TYPE MATERIAL: holotype worker from New Caledonia labelled: "NEW CAL. Toili River, Col d'Amieu For. Stn. 21.35S, 165.47E, 21 Feb. 1977 350 m, P. Ward, disturbed rainforest, beside stream"; 1 paratype worker, same data and collection as the holotype [ANIC].

DERIVATIO NOMINIS: from the Latin *politus* (= smooth), referred to the integumental sculpture.

DIAGNOSIS. A *Proceratium* species belonging to the *silaceum* clade and resembling *caledonicum*, but differing from it, in the worker, by the much broader frontal carinae and by the shorter erect hairs.

DESCRIPTION. *Worker* (Fig. 131). Head slightly longer than broad and with the sides gently diverging posteriorly. Vertex in full face view gently convex. Clypeus reduced and as long as the antennal sockets. Anterior border of the clypeus truncate. Frontal carinae very broad and weakly covering the antennal insertions. Lateral expansions of the frontal carinae broad, little raised, diverging on the two anterior fourths, converging on the third fourth, subparallel and carinate only on the posterior fourth. Frontal area concave and with a thin longitudinal carina faintly prolonging posteriorly. Head anterolaterally with a short, longitudinal carina. Genal carinae superficially marked but short, each carina corresponding to the external border of a superficial sulcus. Eyes visible as a dark dot below the integument, small and on the middle of the head sides. First funicular joint almost as broad as long. Funicular joints 2-10 broader than long. Last funicular joint as long as

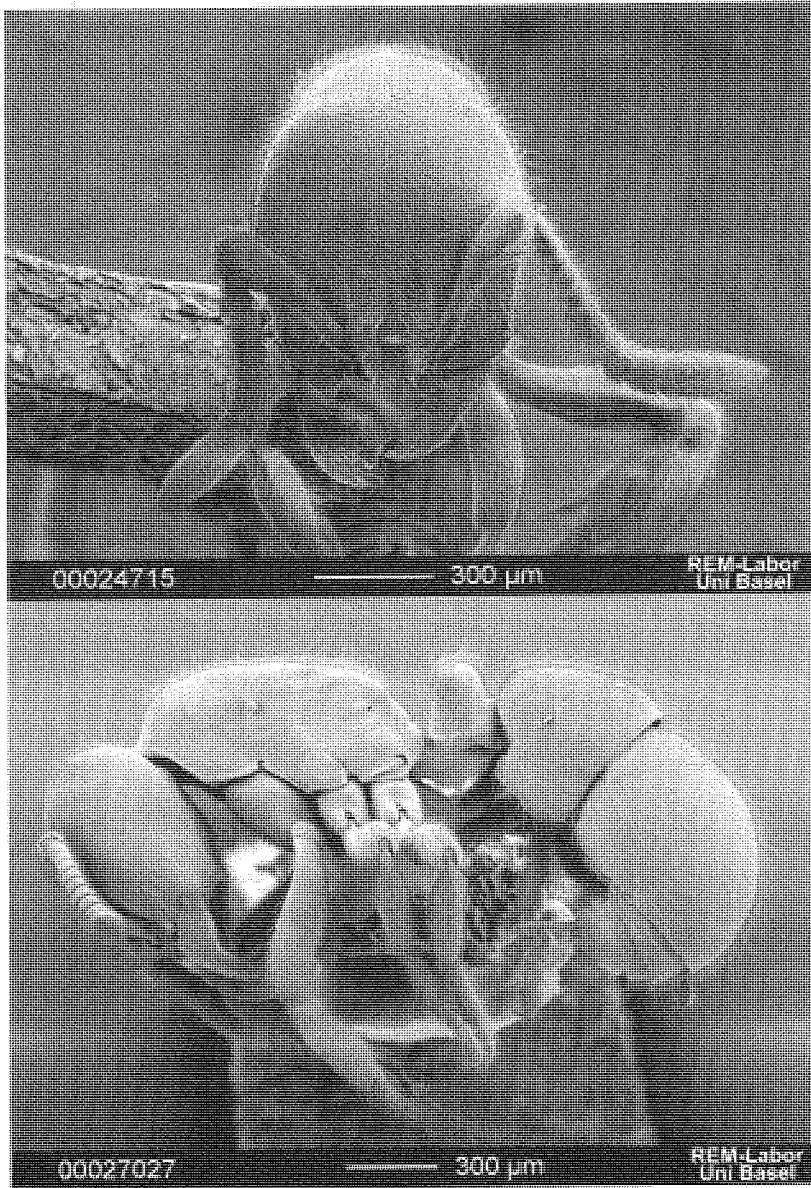


Fig. 131 – *Proceratium politum* de Andrade. Worker (paratype) from Toili River, Col d'Amieu, New Caledonia: head (top) in dorsal view and meso- and metasoma (bottom) in side view.

the sum of joints 6-10. Scapes short of the vertexal margin and gently thickening apically. Masticatory margin of the mandibles with 6-10 denticles before the pointed apical tooth. Palp formula 2,2.

Mesosoma weakly convex in profile and as long as the maximum head length (mandibles included). Pronotal and propodeal sutures absent. Basal face of the propodeum declivous posteriorly. Area between the basal and declivous faces of the propodeum weakly concave and poorly angulate on each side. Declivous face of the propodeum sloping posteriorly. Sides of the declivous face of the propodeum submarginate. Propodeal spiracle round and above mid height in lateral view.

Petiole subrectangular and not very thick. Anterior border of the petiole straight and anterolaterally carinate. Ventral process of the petiole large, subtriangular and pointed posteriorly. Postpetiole 1/3 shorter than gastral tergite II. Postpetiole in dorsal view with the sides gently convex. Postpetiolar sternite anteromedially with a marked subtriangular projection, gently convex posteriorly in side view. Constriction between postpetiole and gaster impressed. Gastral tergite I convex on the curvature. Remaining gastral tergites and sternites curved ventrally.

Legs not very elongate. All tibiae with a pectinate spur. Spurs of fore legs without basal spine. Fore basitarsi longer than the mid ones. Hind basitarsi about 1/5 shorter than hind tibiae. Second tarsomere of hind legs shorter than pretarsus. Pretarsal claws simple. Arolia absent.

Sculpture. Body shining. Head minutely punctate, the punctures denser and mixed with irregular reticulation-rugosities below the eyes. Mesosoma, petiole, postpetiole, gaster and legs with minute piligerous punctures smaller than those on the head. Petiole with sparse, minute granulation.

Body covered by hairs of three main types: (1) short, dense, suberect or subdecumbent on the whole body, suberect and sparse on the funicular joints; (2) longer than type (1), erect on the whole body, shorter than in *caledonicum*, absent from the antennae; (3) shorter than hair type (1), dense and decumbent on the funicular joints only. In addition the funicular joints bear whitish, thick, appressed, sparse hairs, and the scapes with sparse hairs similar to type (2) but shorter.

Colour. Ferruginous-orange with slightly lighter legs.

Measurements in mm and Indices: TL 3.16-3.47; HL 0.69-0.74; HW 0.64-0.69; EL 0.04-0.05; SL 0.46-0.49; WL 0.91-1.00; PeL 0.22-0.23; PeW 0.33-0.35; HFeL 0.54-0.57; HTiL 0.45-0.47; HBaL 0.35-0.38; LS4 0.35-0.39; LT4 0.69-0.76; CI 92.7-93.2; SI 66.2-66.6; IGR 0.51.

MATERIAL EXAMINED: NEW CALEDONIA: Toili River, Col d'Amieu Forest Station, 21° 35' S, 165° 47' E, 21.II.1977, 350 m, 2 workers (holotype and paratype), P. Ward [ANIC].

DISCUSSION. *P. politum* and *caledonicum* are the sole *Proceratium* species recorded from New Caledonia so far. They resemble each other by having a shining body and propodeal sides at most angulate. The characters distinguishing them are given in their relative diagnoses.

DISTRIBUTION: New Caledonia.

***Proceratium caledonicum* de Andrade n. sp.**

Fig. 132

TYPE MATERIAL: holotype worker (unique) labelled: "NEW CALEDONIA, Mt. Koghis nr. Noumea, 500 m, S & J Peck, 26-vii-1978, Berlesate rainforest litter", in ANIC.

DERIVATIO NOMINIS: "*caledonicum*" is a neologism indicating the provenance of the species from New Caledonia.

DIAGNOSIS. A *Proceratium* species belonging to the *silaceum* clade, resembling *politum* and *terraealtae*, but differing from both, in the worker, by the much narrower frontal carinae, from *politum* only, in the worker, by the erect hairs longer; and from *terraealtae* only, in the worker, by the SI < 65 instead of > 70.

DESCRIPTION. *Worker* (Fig. 132). Head slightly longer than broad and with posteriorly diverging sides. Vertex in full face view convex. Clypeus reduced and as long as the antennal sockets. Anterior border of the clypeus truncate. Frontal carinae very narrow, about 1/4 of the head width, not covering the antennal insertions. Lateral expansions of the frontal carinae nar-

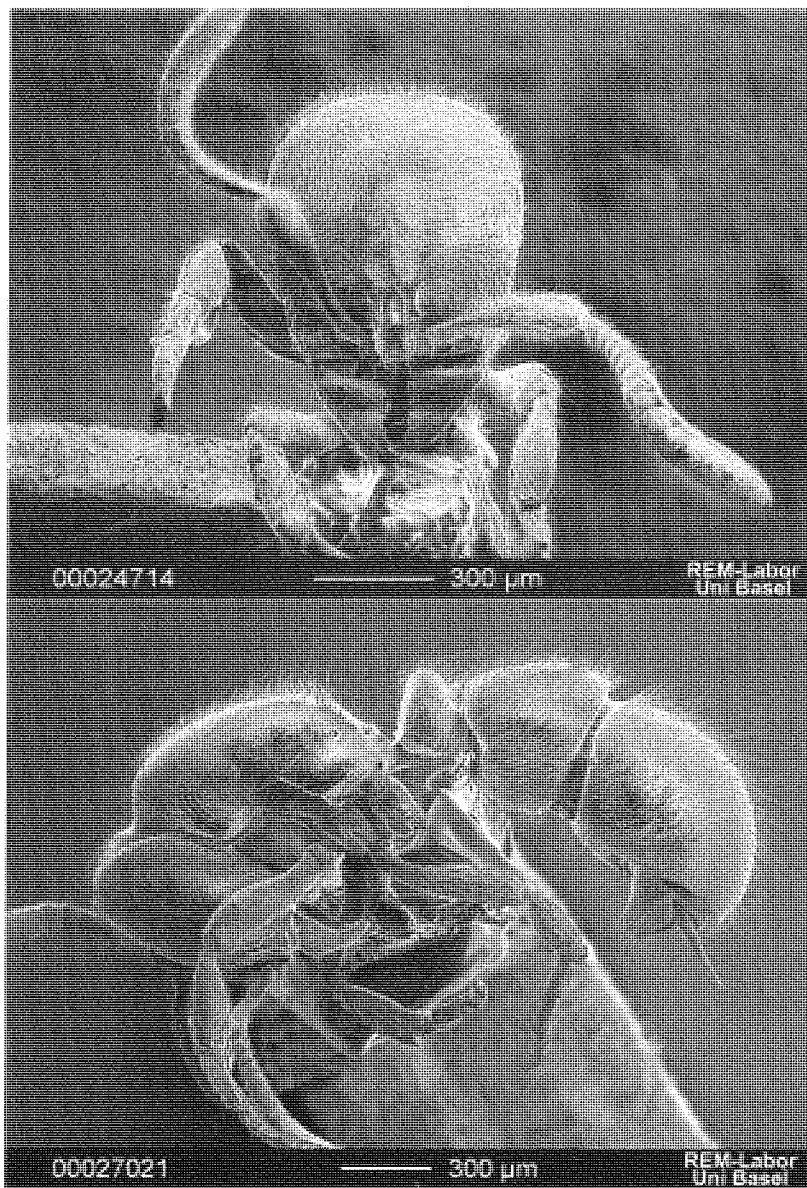


Fig. 132 – *Proceratium caledonicum* de Andrade. Worker (holotype) from Mountain Koghis nr. Noumea, New Caledonia: head (top) in dorsal view and meso- and metasoma (bottom) in side view.



row, little raised, diverging on the two anterior fourths, converging on the third fourth, diverging and carinate only on the posterior fourth. Frontal area concave on the third fourth and with a marked, short longitudinal carina prolonging posteriorly. Head anterolaterally with a short, longitudinal carina. Genal carinae marked, each carina corresponding to the external border of a deep sulcus. Eyes visible as a dark dot below the integument, small and on the middle of the head sides. First funicular joint slightly broader than long. Funicular joints 2-10 broader than long. Last funicular joint as long as the sum of joints 6-10. Scapes short of the vertexal margin and gently thickening apically. Masticatory margin of the mandibles with 6-8 irregular denticles before the pointed apical tooth. Palp formula 2,2.

Mesosoma weakly convex in profile, shorter than maximum head length (mandibles included). Pronotal and propodeal sutures absent. Basal face of the propodeum declivous posteriorly. Area between the basal and declivous faces of the propodeum weakly concave and angulate on each side. Declivous face of the propodeum sloping posteriorly. Sides of the declivous face of the propodeum superficially marginate. Propodeal spiracle round and above mid height in lateral view.

Petiole subrectangular and not very thick. Anterior border of the petiole straight and anterolaterally carinate. Ventral process of the petiole large, lamellaceous anteriorly rectangular and posterior pointed. Postpetiole less than 1/3 shorter than gastral tergite I. Postpetiole in dorsal view with the anterior half diverging and the posterior half gently convex. Postpetiolar sternite anteromedially with a marked subtriangular projection, gently convex in side view. Constriction between postpetiole and gaster impressed. Gastral tergite I convex on the curvature. Remaining gastral tergites and sternites curved ventrally.

Legs not very elongate. All tibiae with a pectinate spur. Spurs of fore legs without basal spine. Fore basitarsi longer than the mid ones. Hind basitarsi about 1/4 shorter than hind tibiae. Second tarsomere of hind legs shorter than pretarsus. Pretarsal claws simple. Arolia absent.

Sculpture. Body largely shining and covered by minute piligerous punctures, the punctures denser, resembling minute reticulation with irregular rugosities on the anterolateral third of the head. Legs minutely punctate.

Body covered by hairs of three main types: (1) short, dense, suberect or subdecumbent on the whole body, sparse on the funicular joints; (2) longer

than type (1), erect, relatively dense on the whole body, absent on the antennae; (3) shorter than hair type (1), dense and decumbent on the funicular joints only. In addition the funicular joints bear whitish, thick, appressed, sparse hairs, and the scapes with sparse hairs similar to type (2) but shorter.

Colour. Yellow-light brown.

Measurements in mm and Indices: TL 2.94; HL 0.67; HW 0.63; EL 0.03; SL 0.43; WL 0.81; PeL 0.22; PeW 0.28; HFeL 0.49; HTiL 0.39; HBaL 0.27; LS4 0.35; LT4 0.67; CI 94.0; SI 64.2; IGR 0.52.

MATERIAL EXAMINED: NEW CALEDONIA: Mt. Koghis, near Noumea, 500 m, 26.VII.1978, 1 worker (holotype), S. & J. Peck [ANIC].

DISCUSSION. As already mentioned in the diagnosis, *P. caledonicum* resembles *terraealtae* and *politum*. These three species share the body largely shining, but, in *terraealtae* the head is less shining than in *caledonicum* and *politum*.

DISTRIBUTION: New Caledonia.

***Proceratium terraaltae* de Andrade n. sp.**

Fig. 133

TYPE MATERIAL: holotype worker labelled: "W-MALAYSIA, Pahang, Cameron Hlds., XI.1987, Wheatcroft", in BMNH.

DERIVATIO NOMINIS: from the Latin "*terra alta*", a literal translation of highlands, referred to the Cameron Highlands, the mountains of Malaysia where the species was collected.

DIAGNOSIS. A *Proceratium* species belonging to the *silaceum* clade, resembling *caledonicum*, but differing from it in the worker, by the broader frontal carinae and by the  $SI > 70$  instead of  $< 65$ .

DESCRIPTION. *Worker* (Fig. 133). Head slightly longer than broad and with the sides gently diverging posteriorly. Vertex in full face view weakly convex. Clypeus reduced and as long as the antennal sockets. Anterior border of the clypeus truncate. Frontal carinae broad and not covering the antennal insertions. Lateral expansions of the frontal carinae narrow, little raised, diverging on the two anterior fourths, converging on the third fourth, diverging and carinate only on the posterior fourth. Frontal area gently concave and with a marked longitudinal carina prolonging posteriorly. Head anterolaterally with a short, longitudinal carina. Genal carinae marked, each carina corresponding to the external border of a deep sulcus. Eyes visible as a dark dot below the integument, small and on the middle of the head sides. First funicular joint slightly broader than long. Funicular joints 2-10 broader than long. Last funicular joint as long as the sum of joints 6-10. Scapes short of the vertexal margin and gently thickening apically. Masticatory margin of the mandibles with 8 denticles before the pointed apical tooth. Palp formula 2,2.

Mesosoma weakly convex in profile, shorter than maximum head length (mandibles included). Pronotal and propodeal sutures absent. Basal face of the propodeum declivous posteriorly. Area between basal and declivous faces of the propodeum weakly concave and denticulate on each side. Declivous face of the propodeum sloping posteriorly. Sides of the declivous face of the propodeum weakly marginate. Propodeal spiracle round and above mid height in lateral view.

Petiole subrectangular and not very thick, its anterior border straight and anterolaterally carinate. Ventral process of the petiole large, triangular and curved posteriorly. Postpetiole less than 1/3 shorter than gastral tergite I, with the anterior half diverging and the posterior half gently convex in dorsal view. Postpetiolar sternite anteromedially with a marked subtriangular projection and gently convex posteriorly in profile. Constriction between postpetiole and gaster impressed. Gastral tergite I convex on the curvature. Remaining gastral tergites and sternites curved ventrally.

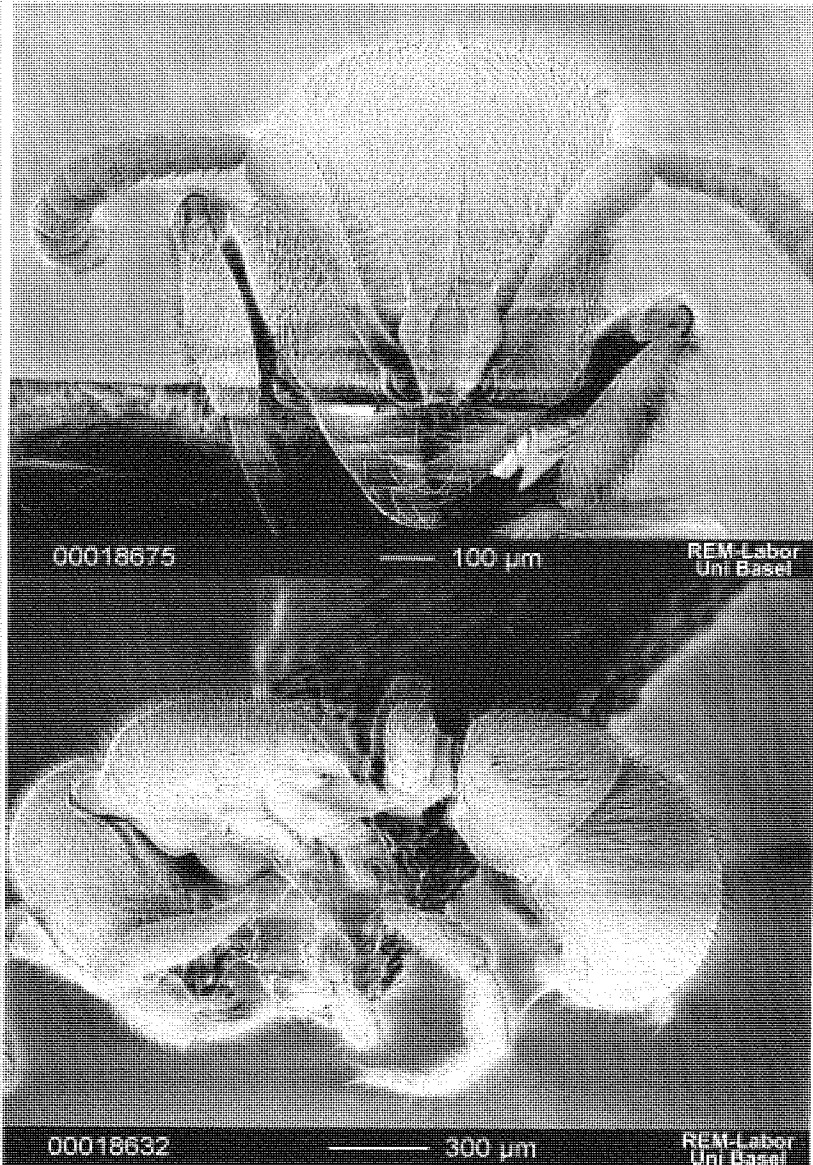


Fig. 133 – *Proceratium terraecaltae* de Andrade. Worker (holotype) from Cameron Highlands, Pahang, Malaysia: head (top) in dorsal view and meso- and metasoma (bottom) in oblique lateral view.

Legs not very elongate. All tibiae with a pectinate spur. Spurs of fore legs without basal spine. Fore basitarsi longer than the mid ones. Hind basitarsi about 1/4 shorter than hind tibiae. Second tarsomere of hind legs shorter than pretarsus. Pretarsal claws simple. Arolia absent.

Sculpture. Body largely shining. Head densely punctate and with sparse, thin, irregular rugosities. Area below the eyes and ventral part of the head reticulorugose. Mesosoma, petiole, postpetiole, gaster and legs minutely punctate.

Body covered by hairs of three main types: (1) short, dense, suberect or subdecumbent on the whole body, sparse on the funicular joints; (2) longer than type (1), erect on the whole body, absent on the antennae; (3) shorter than hair type (1), dense and decumbent on the funicular joints only. In addition the funicular joints bear whitish, thick, appressed, sparse hairs, and the scapes with sparse hairs similar to type (2) but shorter.

Colour. Light brown with lighter legs.

Measurements in mm and Indices: TL 2.72-2.86; HL 0.65-0.67; HW 0.62-0.65; EL 0.03-0.04; SL 0.46-0.48; WL 0.76-0.80; PeL 0.18-0.19; PeW 0.27-0.28; HFeL 0.48-0.49; HTiL 0.41-0.43; HBaL 0.31-0.32; LS4 0.30-0.33; LT4 0.59-0.62; CI 95.4-97.0; SI 70.7-71.6; IGR 0.51-0.53.

MATERIAL EXAMINED: MALAYSIA: PAHANG: Cameron Highlands, XI.1987, 1 worker (holotype), Wheatcroft [BMNH]; same locality, 1500 m, 23.III.1993, 1 worker, Löbl & Calame [BMNH].

DISCUSSION. *P. terraealtae*, for its smooth mesosoma and gaster, is apparently similar to two geographically distant species, i. e. *caledonicum* and *politum*, both from New Caledonia. It can be easily distinguished from both, among other characters, by the head more sculptured and by the denticulate sides of the propodeum.

DISTRIBUTION: Malaysia.

**Proceratium papuanum** Emery

Fig. 134

*Proceratium papuanum* Emery, 1897: 592, pl. 15, fig. 38. Gyne. Original description. Type locality New Guinea. Type material: holotype gyne labelled: "N. Guinea, Biró 96, det. Emery, *papuanum*, Holotypus, *Proceratium papuanum* Emery, 1897, Papp 1974", in HHNM, examined.

*Proceratium carinifrons* Menozzi, 1939: 175, fig. 1 (worker). Worker and gyne. Original description. Type locality: Fort de Kock, Sumatra. Type material: a worker (syntype) labelled: "Fort de Kock, (Sumatra) 920 M. 1926, leg. E. Jacobson", in IEGG, examined. New synonymy.

*Ponera caeca* Donisthorpe, 1949: 491. Worker. Original description. Type locality: New Guinea. Type material: holotype worker labelled: "Maffin Bay, Dutch N. Guinea, VIII-20.44, E. S. Ross Coll, Type, *Ponera caeca* Donis, H. Donisthorpe det, 7.VIII.1946, 64, *Proceratium papuanum* Emery, det. WL Brown, California Academy of Sciences, Type no. 6965"; in CASC, examined. Synonymy with *papuanum* by Brown, 1958a: 248.

*Proceratium carinifrons* Menozzi, Brown, 1958a: 332. Misidentification.

DIAGNOSIS. A *Proceratium* species belonging to the *silaceum* clade, resembling *snellingi*, but differing from it, in the worker and in the gyne, by the broader frontal carinae, by the more superficial body sculpture and by the smaller value of CI ( $\leq 95$  instead of  $\geq 100$ ).

DESCRIPTION. *Worker* (Fig. 134). Head slightly longer than broad and with gently convex sides. Vertex in full face view weakly convex. Clypeus reduced and as long as the antennal sockets. Anterior border of the clypeus truncate. Frontal carinae far from each other, not covering the antennal insertions. Lateral expansions of the frontal carinae very broad, little raised, diverging on the two anterior fourths, converging on the third fourth, diverging and carinate only on the last fourth. Frontal area gently concave on the three anterior fourths and with a central, thick, longitudinal carina starting in the last fourth and prolonging posteriorly; the carina beginning more anteriorly in some specimens. Head anterolaterally with a short, thin, longitudinal carina. Genal carinae marked, each carina corresponding to the external border of a deep sulcus. Eyes visible as a minute, dark dot below the integument, small and on the middle of the head sides. First funicular joint about as broad as long. Funicular joints 2-10 broader than long. Last funicular joint as long as the sum of joints 7-10. Scapes short of the vertexal

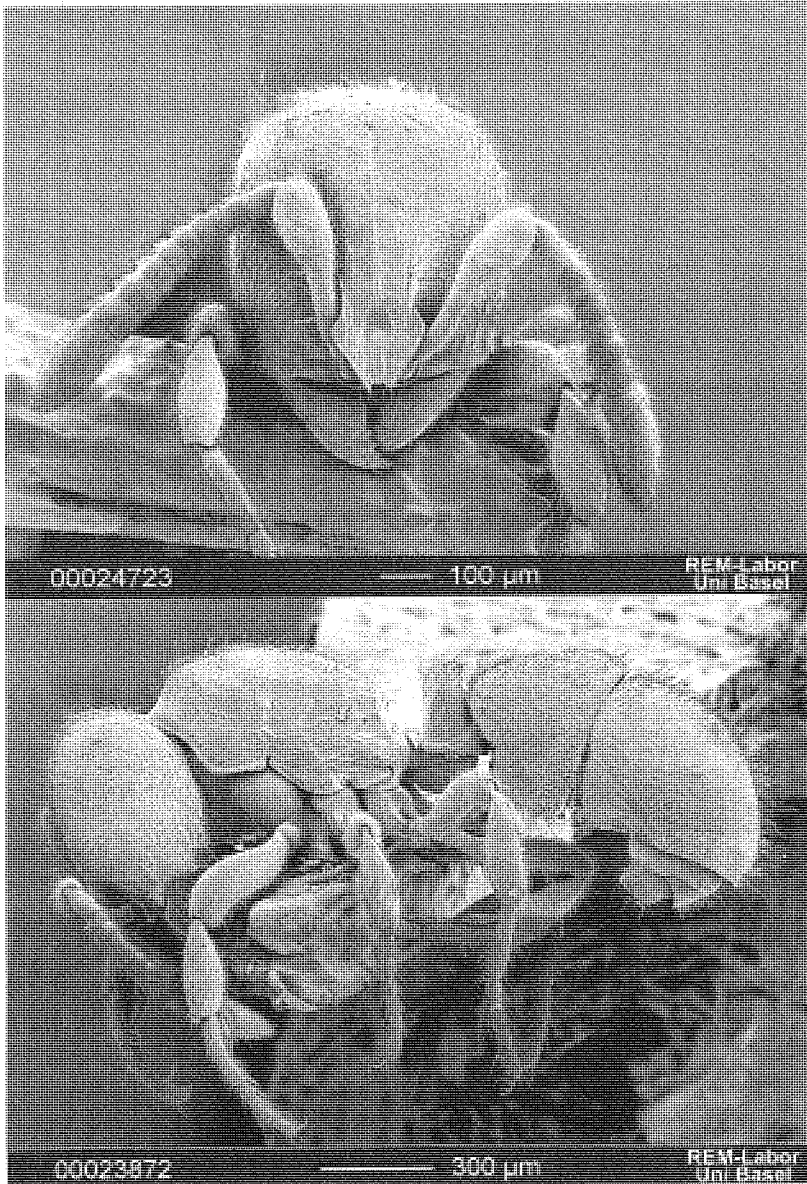


Fig. 134 – *Proceratium papuanum* Emery. Worker from Manus Island, Bowat, Papua New Guinea: head (top) in dorsal view and meso- and metasoma (bottom) in side view.

margin and gently thickening apically. Masticatory margin of the mandibles with 6-7 denticles before the pointed apical tooth. Palp formula 2,2.

Mesosoma convex and shorter than maximum head length (mandibles included) in profile. Pronotal and propodeal sutures absent. Basal face of the propodeum declivous posteriorly. Declivous face of the propodeum gently sloping posteriorly. Area between basal and declivous faces of the propodeum gently concave medially, dorsally superficially carinate and denticulate on each side. Sides of the declivous face superficially carinate. Propodeal spiracle round and above mid height in lateral view.

Petiole subrectangular and narrow. Anterior border of the petiole straight and anterolaterally carinate. Ventral process of the petiole thicker anteriorly, narrowing and slightly pointed posteriorly. Postpetiole in dorsal view with posteriorly diverging sides. Postpetiolar sternite anteromedially with a marked subtriangular projection, gently convex posteriorly in side view. Constriction between postpetiole and gaster impressed. Gastral tergite I about 1/3 longer than the postpetiole and convex on the curvature. Remaining gastral tergites and sternites curved ventrally.

Legs short. Fore tibiae incrassate. Mid and hind tibiae slightly incrassate. All tibiae with a pectinate spur. Spurs of fore legs without basal spine. Fore basitarsi longer than the mid ones. Hind basitarsi about 1/4 shorter than hind tibiae. Second tarsomere of hind legs shorter than pretarsus. Pretarsal claws simple. Arolia absent.

Sculpture. Head, mesosoma, petiole, postpetiole and gaster punctate, the punctures more marked and raised to form small granulation on the mesosoma and on the postpetiole, absent on the center of the posterior half of the first gastral tergite. Head sides with additional longitudinal rugosities. Anterior part of the pronotum and centre of the basal face of the propodeum sometimes with short, transversal rugosities. Legs minutely punctate.

Body covered by hairs of three main types: (1) short, dense, subdecumbent on the whole body, suberect and sparse on the funicular joints; (2) longer than type (1), erect on the whole body, slightly shorter and sparser on the scapes, absent on the funiculi; (3) shorter than hair type (1), dense and decumbent on the funicular joints only. In addition the funicular joints bear whitish, thick, appressed, sparse hairs.



Colour. Ferruginous-light brown with lighter legs.

Measurements in mm and Indices: TL 2.37-2.57; HL 0.55-0.60; HW 0.52-0.56; EL 0.02-0.03; SL 0.36-0.40; WL 0.66-0.70; PeL 0.16-0.19; PeW 0.25-0.27; HFeL 0.39-0.41; HTiL 0.31-0.33; HBaL 0.20-0.24; LS4 0.24-0.27; LT4 0.49-0.55; CI 92.8-94.7; SI 64.3-66.7; IGR 0.48-0.51.

*Gyne*. Differing from the worker in the following details: eyes large, about 1/3 of the head length, composed by many facets and with ocular pilosity. Ocelli well developed.

Mesosoma longer than the head length (mandibles included), robust, convex in side view. Parapsidal furrows marked. Scutellum posteriorly with gently converging sides and with the posterior border subround. Dorsum of the scutellum with a thick longitudinal ruga prolonging to the posterior half of the mesonotum. Metanotum with a small denticle. Basal face of the propodeum medially concave. Area between basal and declivous faces of the propodeum carinate and denticulate on each side.

Colour. Light ferruginous with the posterior half of the head dorsum, center of mesosoma, postpetiole and gaster darker. Legs lighter.

Measurements in mm and Indices: TL 2.92-3.12; HL 0.60-0.64; HW 0.56-0.65; EL 0.19-0.21; SL 0.40-0.42; WL 0.88-0.95; PeL 0.19-0.21; PeW 0.28-0.32; HFeL 0.46-0.50; HTiL 0.36-0.40; HBaL 0.27-0.29; LS4 0.32-0.35; LT4 0.63-0.70; CI 93.3-95.0; SI 64.5-66.7; IGR 0.50-0.51.

MATERIAL EXAMINED: PHILIPPINES: NEGROS: Dumaguete, 1942, 6 workers, J. W. Chapman [MCZC]. LUZON: Lagunas, Mountain Makiling, 21.XI.1995, 1 worker, I. Löbl [BMNH]. MALAYSIA: TERENGGANU: Kuala Buka, near Terengganu, 12.III.1977, 1 gyne, T. Jaccoud & P. Marcuard [ANIC]. PAHANG: Batu Caves, N Kuala Lumpur, 31.III.1993, 1 worker, Löbl & Calame [MHNG]. SABAH: Gunung Silam, 440 m, 1983, 1 worker, R. Leakey [BMNH]. SUMATRA: Fort de Kock, 920 m, 1926, 1 worker (syntype of *Proceratium carinifrons*), E. Jacobson [IEGG]. NEW GUINEA: no further locality, 1 gyne (holotype), 1896, L. Biró [HNHM]. INDONESIA: IRIAN JAYA: Maffin Bay, 20.VIII.1944, 1 worker (holotype of *Ponera caeca*), E. S. Ross [CASC]. PAPUA NEW GUINEA: Manus Island, Bowat, 23 km W Lorengau, 230 m, 20.I-II.1981, rain forest fragment, 2 workers, 1 gyne, W. L. Brown [MCZC]. SOLOMON ISLANDS: SANTA CRUZ ISLANDS: Nemia (?) village, Lum Lum District, 25.II.1964, 1 worker, P.

Greenslade [ANIC]. RUSSELL ISLANDS: Yandina, 22-24.II.1967, 2 workers, 1 gyne, P. J. M. Greenslade [ANIC].

DISCUSSION. The worker from Sabah differs from the other workers examined mainly by the lateral expansions of the frontal carinae less diverging posteriorly and more distant from each other anteriorly. The gyne from Malaysia (Kuala Buka) has denser body sculpture.

The 3 workers and the gyne from Solomon Islands differ from the other specimens of *papuanum* by the much more superficial sculpture, by the slightly narrower frontal carinae, by the propodeal sides less denticulate and by smaller SI values (< 63 instead of > 64).

Since the doubt persists that the Solomon specimens may represent a different species but the material available does not permit a decision, the measurements relative to the Solomon specimens were not included among those reported for *P. papuanum* above.

DISTRIBUTION: Philippines, Malaysia, Sumatra, Papua New Guinea, and Solomon Islands?

***Proceratium hirsutum* de Andrade n. sp.**

Fig. 135

TYPE MATERIAL: holotype worker from Australia labelled: "Qld. c. 5 km SE Paluma Dam, 6.VI.1971, RWT & J. Feehan, rainforest"; paratypes: 2 workers same data as the holotype, all in ANIC.

DERIVATIO NOMINIS: from the Latin *hirsutus* (= hairy) referred to the dense, long hairs of this species.

DIAGNOSIS. A *Proceratium* species belonging to the *silaceum* clade and differing from all the species of this clade by the following combination of worker characters: body with very long hairs, area between basal and declivous propodeal faces subangulate, frontal carinae far from each other, petiolar node thick, and  $SI \geq 74$ .

DESCRIPTION. *Worker* (Fig. 135). Head slightly longer than broad and with the sides gently diverging backwards. Vertex in full face view convex. Clypeus reduced and slightly longer than the antennal sockets. Anterior border of the clypeus truncate. Frontal carinae far from each other, not covering the antennal insertions. Lateral expansions of the frontal carinae very broad, little raised, diverging on the two anterior fourths, converging on the third fourth, slightly diverging and carinate only on the last fourth. Frontal area gently concave in the middle and with a central, thick, longitudinal carina starting from the last fourth and prolonging posteriorly. Head anterolaterally with a short, thin, longitudinal carina. Genal carinae marked, each carina corresponding to the external border of a sulcus. Eyes represented by a minute, dark dot below the integument and on the middle of the head sides. First funicular joint about  $1/3$  longer than broad. Funicular joints 2-10 slightly broader than long. Last funicular joint about as long as the sum of joints 6-10. Scapes short of the vertexal margin and gently thickening apically. Masticatory margin of the mandibles with 6 denticles before the pointed apical tooth. Palp formula 2,2.

Mesosoma convex and about as long as the maximum head length (mandibles included) in profile. Pronotal and propodeal sutures absent. Basal face of the propodeum declivous posteriorly. Declivous face of the propodeum gently sloping posteriorly. Area between basal and declivous faces of the propodeum weakly concave medially and subangulate on each side. Sides of the declivous face superficially carinate. Propodeal spiracle round and above mid height in lateral view.

Petiole subrectangular and narrow, its anterior border straight and anterolaterally narrowly carinate. Ventral process of the petiole triangular. Postpetiole in dorsal view with convex sides. Postpetiolar sternite anteromedially with a marked transversal carina interrupted medially, gently convex posteriorly in side view. Constriction between postpetiole and gaster impressed. Gastral tergite I about  $2/5$  longer than the postpetiole and convex on the curvature. Remaining gastral tergites and sternites curved ventrally.

Legs slightly elongate. All tibiae with a pectinate spur. Spurs of fore legs without basal spine. Fore basitarsi longer than the mid ones. Hind basitarsi about  $1/8$  or  $1/9$  shorter than hind tibiae. Second tarsomere of hind legs

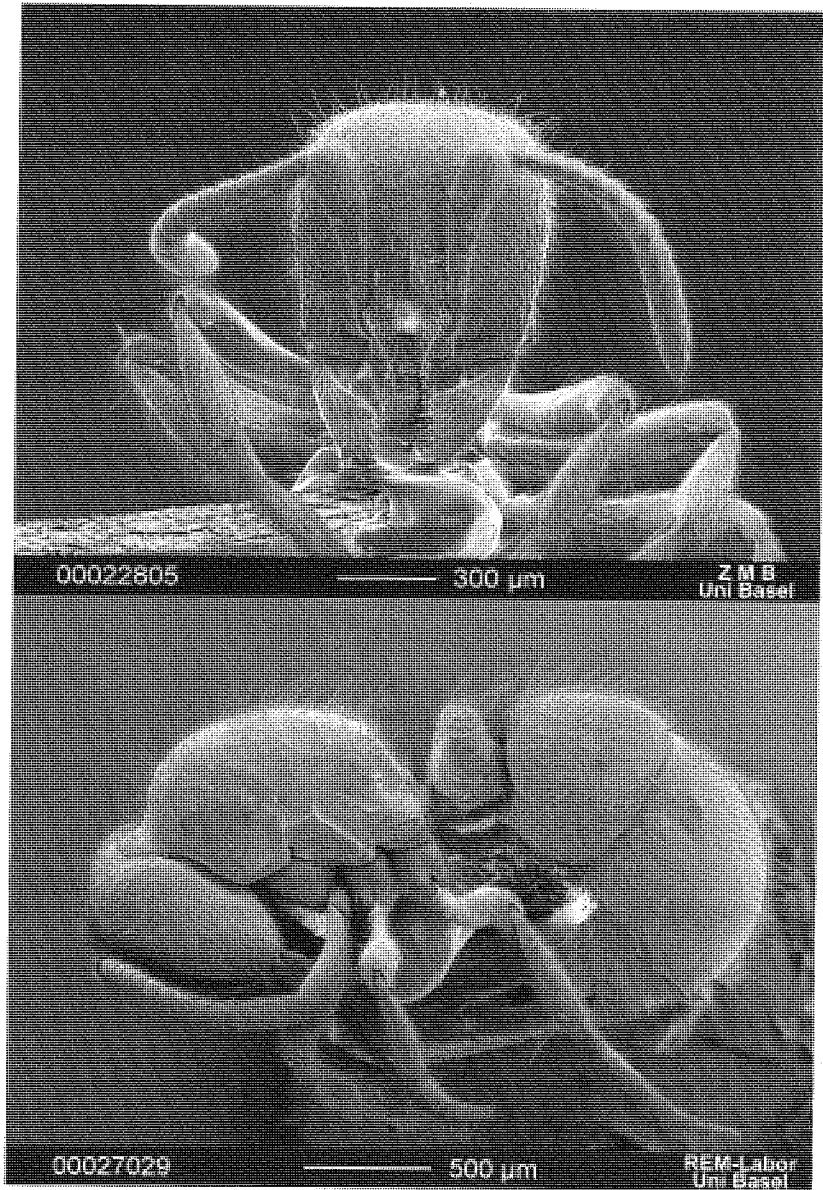


Fig. 135 – *Proceratium hirsutum* de Andrade. Worker (paratype) from Paluma Dam, Queensland, Australia: head (top) in dorsal view and meso- and metasoma (bottom) in side view.

about as long as the pretarsus. Pretarsal claws simple. Arolia absent.

Sculpture. Head minutely rugosopunctate. Sides of the head with additional, small reticulation. Mesosoma, petiole and postpetiole with minute punctation-granulation. Gaster and legs with minute piligerous punctures.

Body covered by hairs of three main types: (1) short, dense, subdecumbent on the whole body, suberect and sparse on the funicular joints; (2) long, erect or suberect on the whole body, slightly shorter on the antennal scapes, absent on the funiculi; (3) shorter than hair type (1), dense and decumbent on the funicular joints only. In addition the funicular joints bear whitish, thick, appressed, sparse hairs.

Colour. Yellow-light brown.

Measurements in mm and Indices: TL 3.35-3.62; HL 0.75-0.81; HW 0.69-0.76; EL ~0.05; SL 0.56-0.60; WL 0.96-1.06; PeL 0.25-0.27; PeW 0.35-0.37; HFeL 0.62-0.68; HTiL 0.49-0.54; HBaL 0.43-0.49; LS4 0.36-0.39; LT4 0.74-0.78; CI 92.0-93.8; SI 74.1-74.7; IGR 0.48-0.50.

MATERIAL EXAMINED: AUSTRALIA: QUEENSLAND: Paluma Dam, 6.VI.1971, 3 workers (holotype and paratypes), R. W. Taylor & J. Feehan, [ANIC].

DISCUSSION. *P. hirsutum*, with a  $SI \geq 74$ , exhibits the second highest SI value within the *silaceum* clade, surpassed only by *relictum* (SI 77.7). *Hirsutum* differs from *relictum* mainly in the shape of the petiole, dorsally convex instead of flattened, but it shares with *relictum* the hind basitarsi only slightly shorter than hind tibiae. *Hirsutum* shares with *banjaranense* the abundant long hairs, but it differs from *banjaranense* by the more superficial sculpture, larger frontal carinae and longer scapes. *Hirsutum*, moreover, shares with *gigas* the broad, diverging frontal carinae, but *hirsutum* has denser and longer hairs and a more superficial integumental sculpture.

DISTRIBUTION: Australia (Queensland).

**Proceratium siamense** de Andrade n. sp.

Fig. 136

TYPE MATERIAL: holotype worker labelled: "THAILAND, Doi Inthanon, 7.XI.85, Löbl & Burckhardt", in MHNG; one paratype worker, same data as the holotype in BMNH.

DERIVATIO NOMINIS: *siamense* is a neologism indicating the provenance from Thailand.

DIAGNOSIS. A *Proceratium* species belonging to the *silaceum* clade, resembling *australe*, but differing from it, in the worker, by the thicker petiole and by the hairs of type 2 denser and longer.

DESCRIPTION. *Worker* (Fig. 136). Head longer than broad and with the sides gently diverging posteriorly. Vertex in full face view slightly convex. Clypeus reduced and as long as the antennal sockets. Anterior border of the clypeus truncate. Frontal carinae not very far from each other, slightly covering the antennal insertions. Lateral expansions of the frontal carinae narrow, little raised, strongly diverging on the two anterior fourths, converging on the third fourth, subparallel and carinate only on the last fourth. Frontal area gently concave on the three anterior fourths and with a central longitudinal carina starting from the last fourth and prolonging posteriorly. Head anterolaterally with a thick, short, longitudinal carina. Genal carinae marked, each carina corresponding to the external border of a deep sulcus. Eyes visible as a dark dot below the integument, small and on the middle of the head sides. First funicular joint about as long as broad. Funicular joints 2-10 broader than long. Last funicular joint as long as the sum of joints 7-10. Scapes short of the vertexal margin and weakly thickening apically. Masticatory margin of the mandibles with 6-7 denticles before the pointed apical tooth. Palp formula 2,2.

Mesosoma in side view gently convex and about as long as the maximum head length (mandibles included). Pronotal and propodeal sutures absent. Basal face of the propodeum declivous posteriorly. Declivous face of the propodeum almost perpendicular to the basal face. Area between basal and declivous faces of the propodeum medially weakly concave, dorsally marginate and laterally denticulate. Sides of the declivous face of the propodeum weakly marginate. Propodeal spiracle round and above mid height in lateral view.

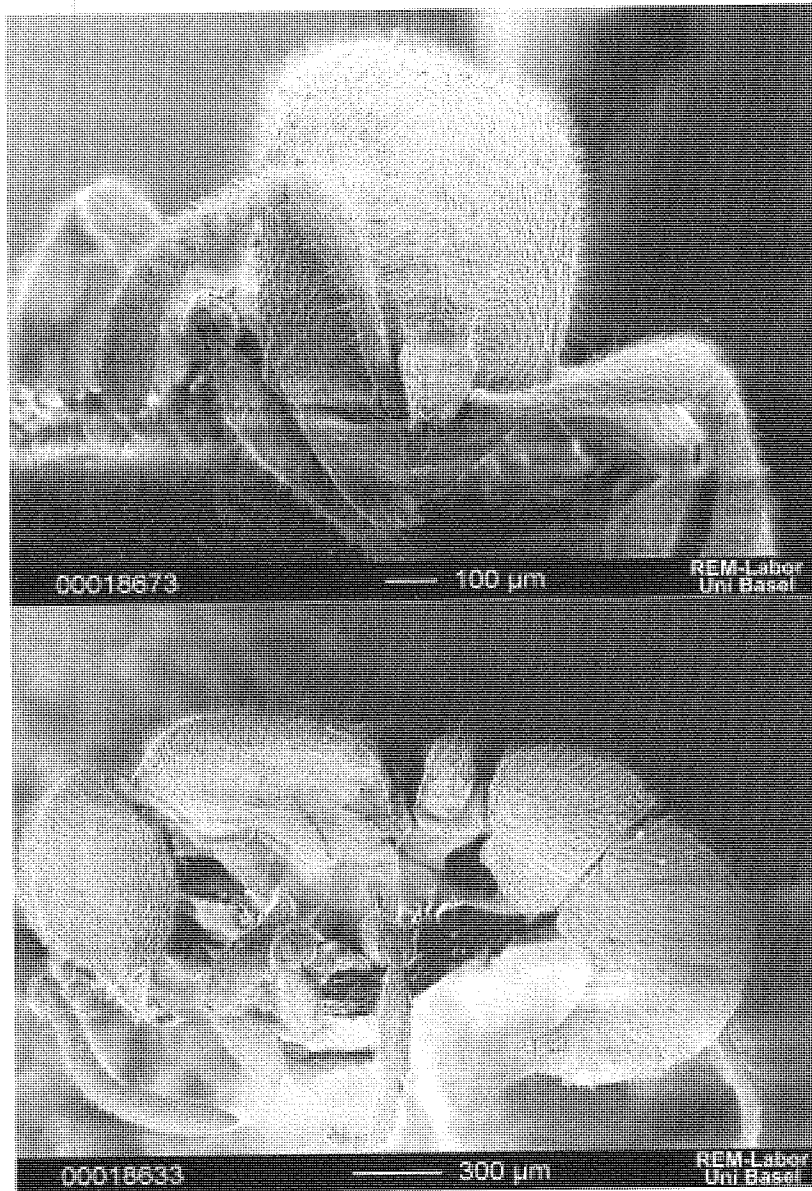


Fig. 136. – *Proceratium siamense* de Andrade. Worker (paratype) from Doi Inthanon, Thailand: head (top) in dorsal view and meso- and metasoma (bottom) in side view.

Petiole subrectangular and thick. Anterior border of the petiole straight and anterolaterally strongly carinate. Ventral process of the petiole very large, stout and triangular. Postpetiole in dorsal view with sides gently diverging posteriorly. Postpetiolar sternite anteromedially with a marked subtriangular projection, gently convex posteriorly in side view. Constriction between postpetiole and gaster impressed. Gastral tergite I about 2/5 longer than the postpetiole and convex on the curvature. Remaining gastral tergites and sternites curved ventrally.

Legs not very short. All tibiae with a pectinate spur. Spurs of fore legs without basal spine. Fore basitarsi longer than the mid ones. Hind basitarsi about 1/4 shorter than hind tibiae. Second tarsomere of hind legs shorter than pretarsus. Pretarsal claws simple. Arolia absent.

Sculpture. Head, mesosoma, petiole and postpetiole granulopunctate. Sides of the head and pleurae with additional irregular rugosities. Gaster smooth and with minute piligerous punctures. Legs punctate.

Body covered by hairs of three main types: (1) short, dense, suberect or subdecumbent on the whole body, suberect and sparse on the funicular joints; (2) long, erect on the whole body, slightly shorter on the scapes, absent on the funiculi; (3) shorter than hair type (1), dense and decumbent on the funicular joints only. In addition the funicular joints bear whitish, thick, appressed, sparse hairs.

Colour. Light brown.

Measurements in mm and Indices: TL 3.20-3.26; HL 0.71-0.72; HW 0.64-0.65; EL 0.03-0.04; SL 0.49-0.50; WL 0.90; PeL 0.23-0.24; PeW 0.32-0.33; HFeL 0.52-0.53; HTiL 0.44-0.45; HBaL 0.33-0.34; LS4 0.38; LT4 0.75-0.77; CI 90.1-90.3; SI 69.0-69.4; IGR 0.49-0.51.

MATERIAL EXAMINED: THAILAND: Doi Inthanon, 7.XI.1985, 1 worker (holotype) [MHNG], 1 worker (paratype) [BMNH], Löbl & Burckhardt [MHNG, BMNH].

DISCUSSION. As already written in the diagnosis, *P. siamense* resembles *australe* in general body shape. The two species *siamense* and *australe* share the area between the basal and declivous faces of the propodeum with a variably marked transversal carina.

DISTRIBUTION: Thailand.



**Proceratium australe** de Andrade n. sp.

Fig. 137

*Proceratium papuanum* Emery, Brown, 1958a: 335. A worker from Tamborine Mount, Queensland. Nec Emery, 1897.

TYPE MATERIAL: holotype worker from Australia labelled: "QUEENSLAND, 17.10S, 145.39E, Boar Pocket, rainforest, 720m, R. W. Taylor, 9-12.X.1986, ANIC ANTS VIAL 44.122"; seven paratype workers and one paratype gyne, same data as the holotype; holotype worker, 5 paratype workers and 1 paratype gyne, in ANIC, 2 paratype workers in MZSP.

DERIVATIO NOMINIS: "*australe*" is a neologism indicating the provenance from Australia.

DIAGNOSIS. A *Proceratium* species belonging to the *silaceum* clade and resembling *siamense*, but differing from it, in the worker, by the narrower petiole and by the hairs of type 2 shorter.

DESCRIPTION. *Worker* (Fig. 137). Head slightly longer than broad and with the sides gently diverging posteriorly. Vertex in full face view almost straight. Clypeus reduced and as long as the antennal sockets. Anterior border of the clypeus truncate. Frontal carinae not very far from each other, slightly covering the antennal insertions. Lateral expansions of the frontal carinae not very narrow, little raised, strongly diverging on the two anterior fourths, converging on the third fourth, subparallel and carinate only on the last fourth. Frontal area gently concave on the three anterior fourths and with a central longitudinal carina starting from the last fourth and prolonging posteriorly. Head anterolaterally with a thick, short, longitudinal carina. Genal carinae marked, each carina corresponding to the external border of a deep sulcus. Eyes visible as a dark dot below the integument, small and on the middle of the head sides. First funicular joint about as long as broad. Funicular joints 2-10 broader than long. Last funicular joint as long as the sum of joints 6-10. Scapes short of the vertexal margin and gently thickening apically. Masticatory margin of the mandibles with 7-8 denticles before the pointed apical tooth. Palp formula 2,2.

Mesosoma gently convex and about as long as the maximum head length (mandibles included) in profile. Pronotal and propodeal sutures absent. Basal face of the propodeum declivous posteriorly. Declivous face of the propodeum flat. Area between the basal and declivous faces of the

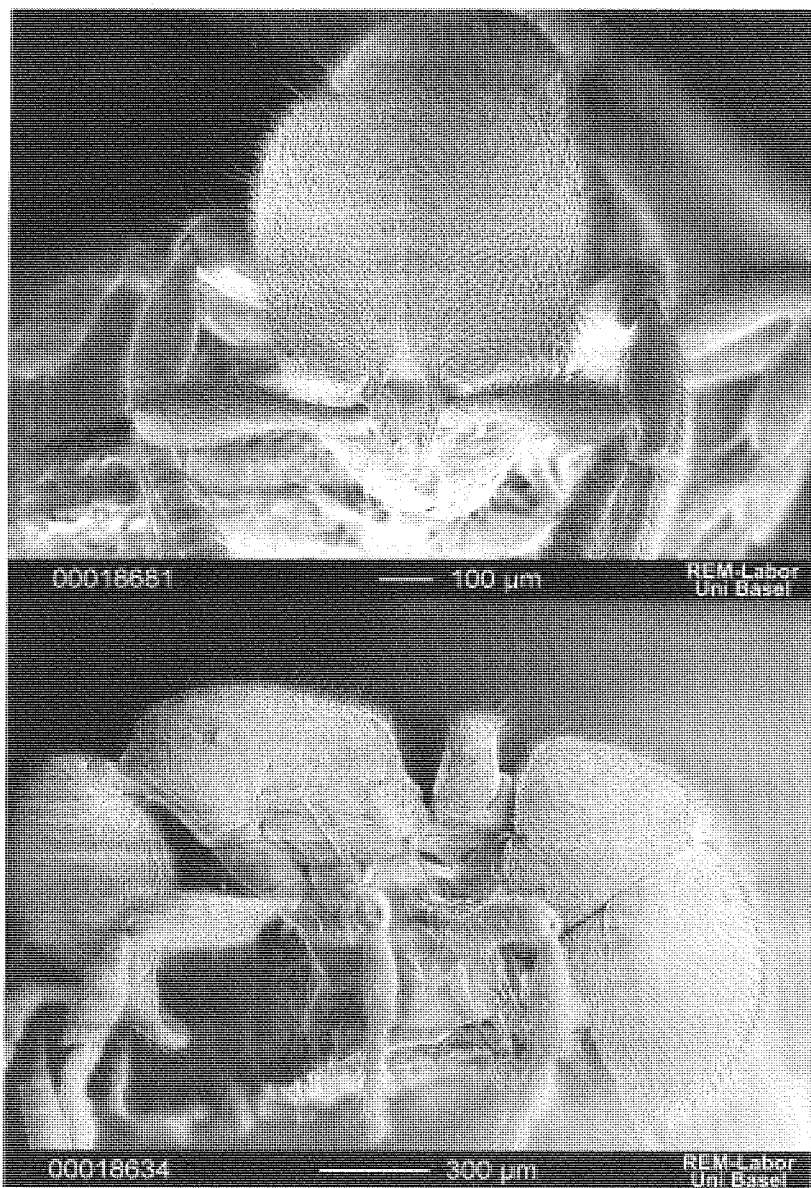


Fig. 137 – *Proceratium australe* de Andrade. Worker (paratype) from Queensland, Boar Pocket, Australia: head (top) in dorsal view and meso- and metasoma (bottom) in side view.

propodeum weakly concave, dorsally carinate and laterally angulate. Sides of the declivous face of the propodeum carinate. Propodeal spiracle round and above mid height in lateral view.

Petiole subrectangular and not very narrow; its anterior border straight and anterolaterally carinate. Ventral process of the petiole spine-like and directed backwards. Postpetiolar sternite anteromedially with a marked subtriangular projection, gently convex posteriorly in side view. Constriction between postpetiole and gaster impressed. Gastral tergite I about 1/3 longer than the postpetiole and convex on the curvature. Posterior border of the gastral tergite I thick and irregular. Remaining gastral tergites and sternites curved ventrally.

Legs not very short. All tibiae with a pectinate spur. Spurs of fore legs without basal spine. Fore basitarsi longer than the mid ones. Hind basitarsi about 1/4 shorter than hind tibiae. Second tarsomere of hind legs about as long as the pretarsus. Pretarsal claws simple. Arolia absent.

Sculpture. Anterior half of the head and head sides with dense piligerous foveae mixed with irregular rugosities. Posterior half of the head dorsum, mesosoma, petiole and postpetiole densely punctate and with very sparse, short, irregular, rugosities, the punctures more superficial on the anterior half of the mesosoma. In addition the propodeal dorsum, petiole and postpetiole with sparse granulation. Gaster smooth and with minutely piligerous punctures denser and larger on the sides. Legs punctate.

Body covered by hairs of three main types: (1) short, dense, subdecumbent on the whole body, suberect and sparse on the funicular joints; (2) longer than type (1), erect on the whole body, slightly shorter on the scapes, absent on the funiculi; (3) shorter than hair type (1), dense and decumbent on the funicular joints only. In addition the funicular joints bear whitish, thick, appressed, sparse hairs.

Colour. Light ferrugineous with lighter antennae and legs.

Measurements in mm and Indices: TL 2.56-3.44; HL 0.60-0.77; HW 0.54-0.73; EL 0.03-0.04; SL 0.39-0.51; WL 0.69-0.97; PeL 0.18-0.23; PeW 0.27-0.34; HFeL 0.41-0.58; HTiL 0.34-0.46; HBaL 0.26-0.36; LS4 0.28-0.36; LT4 0.55-0.72; CI 90.0-95.8; SI 63.9-68.7; IGR 0.48-0.52.

*Gyne*. Differing from the worker in the following details: eyes large, slightly less than 1/3 of the head length, composed by many facets and with ocular pilosity. Ocelli well developed.

Mesosoma robust and convex in side view. Parapsidal furrows marked. Scutellum with the sides gently converging posteriorly and with the posterior border subtruncate. Dorsum of the scutellum with a thick longitudinal carina. Metanotum with a small tooth. Basal face of the propodeum medially concave. Area between the basal and declivous faces of the propodeum carinate and subangulate on each side.

Measurements in mm and Indices: TL 3.14-3.75; HL 0.65-0.74; HW 0.61-0.73; EL 0.14-0.21; SL 0.43-0.51; WL 0.94-1.10; PeL 0.22-0.23; PeW 0.33-0.37; HFeL 0.52-0.61; HTiL 0.42-0.49; HBaL 0.33-0.39; LS4 0.34-0.44; LT4 0.68-0.90; CI 93.8-98.6; SI 65.7-68.9; IGR 0.47-0.50.

MATERIAL EXAMINED: AUSTRALIA: QUEENSLAND: 17°10' S, 145°39' E Boar Pocket, rainforest, 720 m, 9-12.X.1986, 1 worker (holotype), 6 workers (paratypes), 1 gyne (paratype), R. W. Taylor [ANIC, MZSP]; Tamborine Mountain, 15.V.1951, rainforest, 1 worker, W. L. Brown [MCZC]; Montville, Blackall range, 2000', IV.1958, rain forest, 2 workers, 1 gyne, P. F. Darlington [MCZC]; Malanda, 700 m, 8.XI.1962, 1 worker, E. S. Ross & D. Q. Cavagnaro [CASC]; Landsborough, 6.V.1962, 1 gyne, R. W. Taylor [ANIC]; Cooper Creek, 145°26' E, 16°11' S, near Daintree, 22.VI.1971, 1 gyne, R. W. Taylor & J. Feehan [ANIC]; 26°36' S, 152°43' E, near Kenilworth, rainforest, 150 m, 17.III.1973, 1 gyne, R. W. Taylor [ANIC]; Lamington National Park (O'Reillys), 28°14' S, 153°08' E, 920 m, 21.III.1973, ex rotting log, 11 workers, R. W. Taylor & R. Kohout [ANIC]; 3 km S of Eungella, 780 m, rainforest, 2-3.V.1973, 10 workers, ex rotting wood piece, R. W. Taylor [ANIC]; Cooloola, 16.II & 23.II.1977, rainforest, 2 workers, 1 gyne, P. J. M. Greenslade [ANIC]; Mt Macartney, Cathu SF, 21.IV.1979, rainforest, 700-850 m, stick brushing, 1 worker, G. Monteith [ANIC]; Lake Eacham National Park, 17°17' S, 145°38' E, 30.V.1980, ex rotten log, 18 workers, P. Ward [ANIC]; Kroombit Tops, 45 km SSW Calliope, 10.XII.1983, open forest, 940 m, sieved litter, 2 workers, Monteith, Davies, Gallon & Thompson [ANIC]; Upper Tallebudgera Creek, below Springbrook, SE Queensland, 8.I.1984, rainforest, 550 m, sieved litter, 1 worker, Monteith & Thompson [ANIC]. NEW SOUTH WALES: N of Dunoon, IV.1958, 1 worker, Darlington [MCZC]; 4 mi E of Berry, 20.XII.1960, 14 workers, B. B. Lowery [ANIC]; Breakfast Creek, 1400', Mount Warning, N NSW, 5.IX.1962, 4 workers, nest under small rock, B. B. Lowery [ANIC]; Brunswick Heads, Faunal Res., NE NSW, in rotten log, 6.IX.1966, 8 work-

ers, 1 gyne, B. B. Lowery [ANIC]; Buttingbah Range, NE NSW, 200', 10 mi S of Murwillumbah, 31.VIII.1967, hard clay soil, under rock, thief ant in gallery of another species, 1 worker, B. B. Lowery [ANIC]; Colenugil State Forest, 15 mi SE of Grafton NE NSW, 300', 24.VIII.1967, 1 worker, B. B. Lowery [ANIC]; Mount Kembla, 4.IV.1972, 1 worker, E. G. Kearney [ANIC]; Whian Whian State Forest, 16 & 17.VI.1976, 14.V.1977, ex rotten log, 10 workers, P. Ward [ANIC]; Royal National Park, Sidney, below waterfall, 26.VIII.1976, 12 workers, B. B. Lowery [ANIC]; Barrington Tops NP, Dilgry River, 12.XII.1998, 1 worker [MSNM].

DISCUSSION. *P. australe* is a very variable species. The specimens from Lake Eacham are the most similar to the type series. What we regard as intraspecific variation affects sculptural and structural details listed in the following.

The worker from Tallebudgera Creek has poorly angulate propodeal sides and more superficial sculpture on the mesosoma. The worker from Mt. Kembla and the one from Bruxner Park have more marked postpetiolar sculpture, the erect hairs slightly longer and darker colour. In addition, the worker from Bruxner Park has narrower petiolar node.

The worker from Malanda (Ross & Cavagnaro leg.) has more superficial postpetiolar sculpture, subangulate propodeal sides and narrower petiolar node. A worker from Malanda collected by Brown also has more or less shining sculpture and propodeal sides with the most obtuse trace of angulation according to Brown (1958a).

Part of the workers from Lamington and Roy National Parks are slightly larger (TL  $\geq$  3.26 mm instead of 2.57-3.09 mm).

The gynes from Barry and from Cooloola have small eyes (EL 0.14-0.15 mm instead of 0.19-0.21 mm). The gyne from Landsborough is larger than the other gynes examined (TL 3.75 mm instead of 3.14-3.61 mm). The gyne from Landsborough has higher CI (98.6 as opposed to 93.8-95.8). The gyne from Cooper Creek has very superficial postpetiolar sculpture.

Based on the material available for the present study we prefer to adopt the conservative position of considering all these specimens as belonging to a single, variable species.

DISTRIBUTION: Australia (Queensland, New South Wales).

**Proceratium pumilio** de Andrade n. sp.

Fig. 138

TYPE MATERIAL: holotype worker (unique) from Queensland, Australia labelled: "NE QLD Mt. Demi, 7 km SW of Mossman, 29 Oct 1983, D. K. Yeates & G. I. Thompson, QM Berlesate No. 604, 16.30 S 145.19 E, Rainforest, 1000 m, Sieved litter" in ANIC.

DERIVATIO NOMINIS: from the Latin *pumilio* (Lucretius, Seneca) = dwarf, pygmy, referred to the small size of this species.

DIAGNOSIS. A *Proceratium* species belonging to the *silaceum* clade, resembling *australe* and *caledonicum* but differing from *australe*, in the worker, by the narrower frontal carinae, and from *caledonicum*, in the worker, by the body with stronger sculpture and by the erect hairs shorter, and from both species, by the broader petiole and by the mesosoma more convex in profile.

DESCRIPTION. *Worker* (Fig. 138). Head slightly longer than broad and with the sides weakly diverging posteriorly. Vertex in full face view convex and gently incised medially. Clypeus reduced and as long as the antennal sockets. Anterior border of the clypeus truncate. Frontal carinae not very far from each other, slightly covering the antennal insertions. Lateral expansions of the frontal carinae narrow, little raised, gently diverging on the two anterior thirds, shortly converging, subparallel and carinate only on the last third. Frontal area gently concave and with a central longitudinal carina starting from the posterior border of the concavity and prolonging posteriorly. Head anterolaterally with a short longitudinal carina. Genal carinae marked, each carina corresponding to the external border of a deep sulcus. Eyes composed by a small agglomeration of ommatidia and on the middle of the head sides. First funicular joint about as long as broad. Funicular joints 2-10 broader than long. Last funicular joint as long as the sum of joints 6-10. Scapes short of the vertexal margin and gently thickening apically. Masticatory margin of the mandibles with 5 denticles before the pointed apical tooth. Palp formula 2,2.

Mesosoma convex and slightly shorter than maximum head length (mandibles included) in profile. Pronotal and propodeal sutures absent. Basal face of the propodeum gently declivous posteriorly. Declivous face of the propodeum sloping posteriorly. Area between the basal and declivous

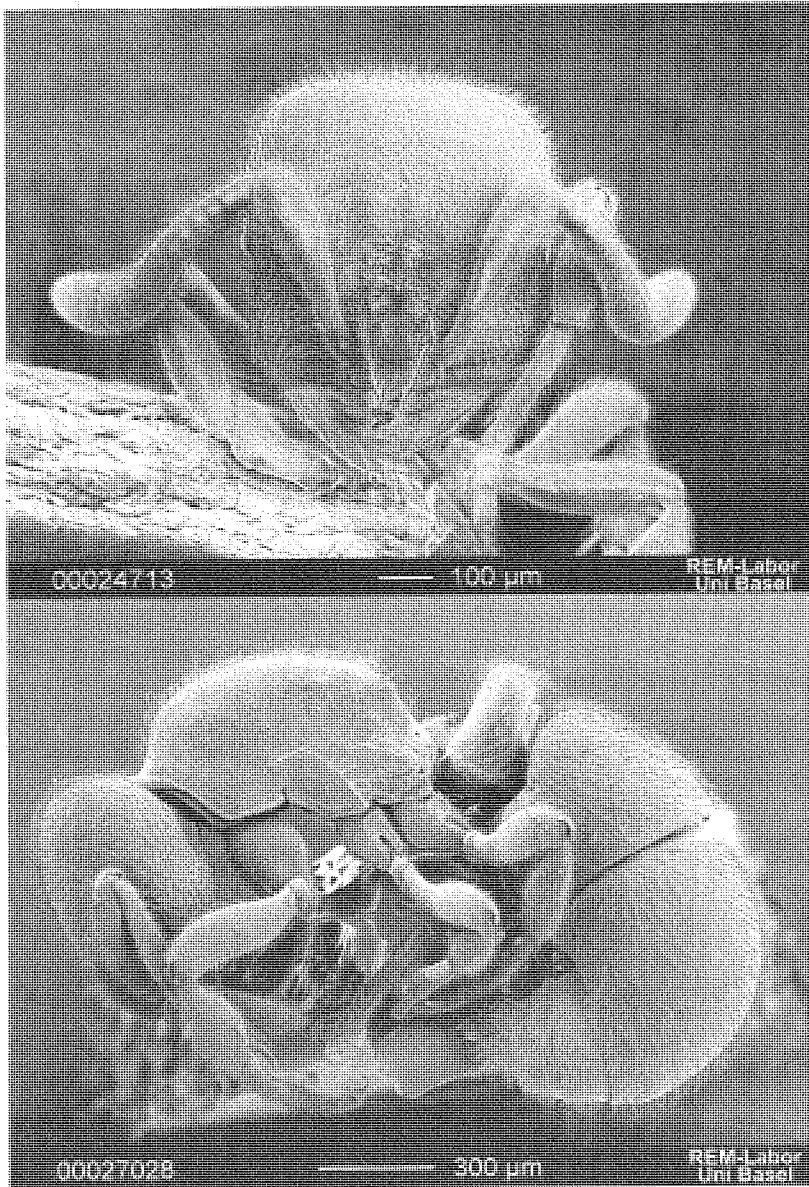


Fig. 138 – *Proceratium pumilio* de Andrade. Worker from Queensland, Australia: head (holotype, top) in dorsal view from Mt. Demi and meso- and metasoma (bottom) in side view from Mt. Sorrow.

faces of the propodeum weakly concave medially and with a minute, carinate denticle on each side. Declivous face superficially marginate laterally. Propodeal spiracle round and above mid height in lateral view.

Petiole subrectangular and narrow. Petiolar width more than 1 and 1/2 broader than long. Anterior border of the petiole straight and anterolaterally weakly carinate. Ventral process of the petiole small and triangular. Postpetiolar sternite anteromedially with a marked subround projection, gently convex in side view. Constriction between postpetiole and gaster impressed. Gastral tergite I about 1/3 longer than the postpetiole and convex on the curvature. Remaining gastral tergites and sternites curved ventrally.

Legs moderately short. All tibiae with a pectinate spur. Spurs of fore legs without basal spine. Fore basitarsi longer than the mid ones. Hind basitarsi about 1/4 shorter than hind tibiae. Second tarsomere of hind legs about as long as the pretarsus. Pretarsal claws simple. Arolia absent.

Sculpture. Head dorsum, mesosoma, petiole and postpetiole punctate, the punctures denser and more impressed on the head, very superficial and resembling minute foveae on the mesosoma. Head sides with dense, small, piligerous foveae resembling reticulation and few, slightly longitudinal rugosities. Gaster smooth and with minute piligerous punctures, the punctures denser and larger on the sides. Legs punctate.

Body covered by hairs of three main types: (1) short, dense, subdecumbent on the whole body, suberect and sparse on the funicular joints; (2) longer than type (1), erect on the whole body, slightly shorter on the scapes, absent on the funiculi; (3) shorter than hair type (1), dense and decumbent on the funicular joints only. In addition the funicular joints bear whitish, thick, appressed, sparse hairs.

Colour. Light brown with lighter antennae and legs.

Measurements in mm and Indices: TL 2.55-2.63; HL 0.58-0.60; HW 0.55-0.56; EL 0.04; SL 0.39-0.41; WL 0.69-0.71; PeL 0.18-0.19; PeW 0.33; HFeL 0.41; HTiL 0.32-0.34; HBaL 0.24-0.26; LS4 0.27-0.29; LT4 0.57-0.58; CI 93.3-94.8; SI 67.2-68.3; IGR 0.47-0.50.

MATERIAL EXAMINED: AUSTRALIA: QUEENSLAND: Mt. Demi, 7 km SW of Mossman, 16°30' S, 145°19' E, 29.IX.1983, rainforest, sieved litter, 1 worker (holotype), D. K. Yeates & G. I. Thompson [ANIC]; Mt. Sorrow



summit, Cape Tribulation, 16°08' S, 145°26' E, 19.X.1980, rainforest, 800 m, sieved litter, 1 worker, G. B. Monteith [ANIC].

DISCUSSION. *P. pumilio* resembles *australe* in general body shape except for the narrower frontal carinae and for the broader petiole width are the main characters distinguishing the two species. For the shape of the frontal carinae *pumilio* resembles also *caledonicum* but both species differ greatly in body sculpture and petiolar width.

DISTRIBUTION: Australia (Queensland).

***Proceratium gracile* de Andrade n. sp.**

Fig. 139

TYPE MATERIAL: holotype worker from Queensland, Australia labelled: "QLD. Mt. Cordeaux, Gunning Hams Gap, 3000', 1.V.1962, R. W. Taylor, rtn. wood forest floor, rainforest, R. W. Taylor, Accession 722, ANIC Ants Vials 35-131", in ANIC; 5 paratype workers, same data and collector as the holotype.

DERIVATIO NOMINIS: From the Latin *gracilis* (= weak) as opposed to the species *robustum*.

DIAGNOSIS. A *Proceratium* species belonging to the *silaceum* clade and resembling *robustum* but differing from it, in the worker, by the following characters: hind tarsomeres longer, CI < 93 (instead of > 94), SI ≥ 69 (instead of < 65) and the by the hairs of type (2) shorter and sparser.

DESCRIPTION. *Worker* (Fig. 139). Head slightly longer than broad and with subparallel sides. Vertex in full face view gently convex. Clypeus reduced and as long as the antennal sockets. Anterior border of the clypeus truncate. Frontal carinae broad and partly covering the antennal insertions. Lateral expansions of the frontal carinae broad, raised, diverging on the two anterior fourths, converging on the third fourth, diverging and carinate only on the posterior fourth. Frontal area concave and with a longitudinal carina prolonging posteriorly. Head anterolaterally with a short, longitudinal carina. Genal carinae superficially marked, each carina corresponding to the

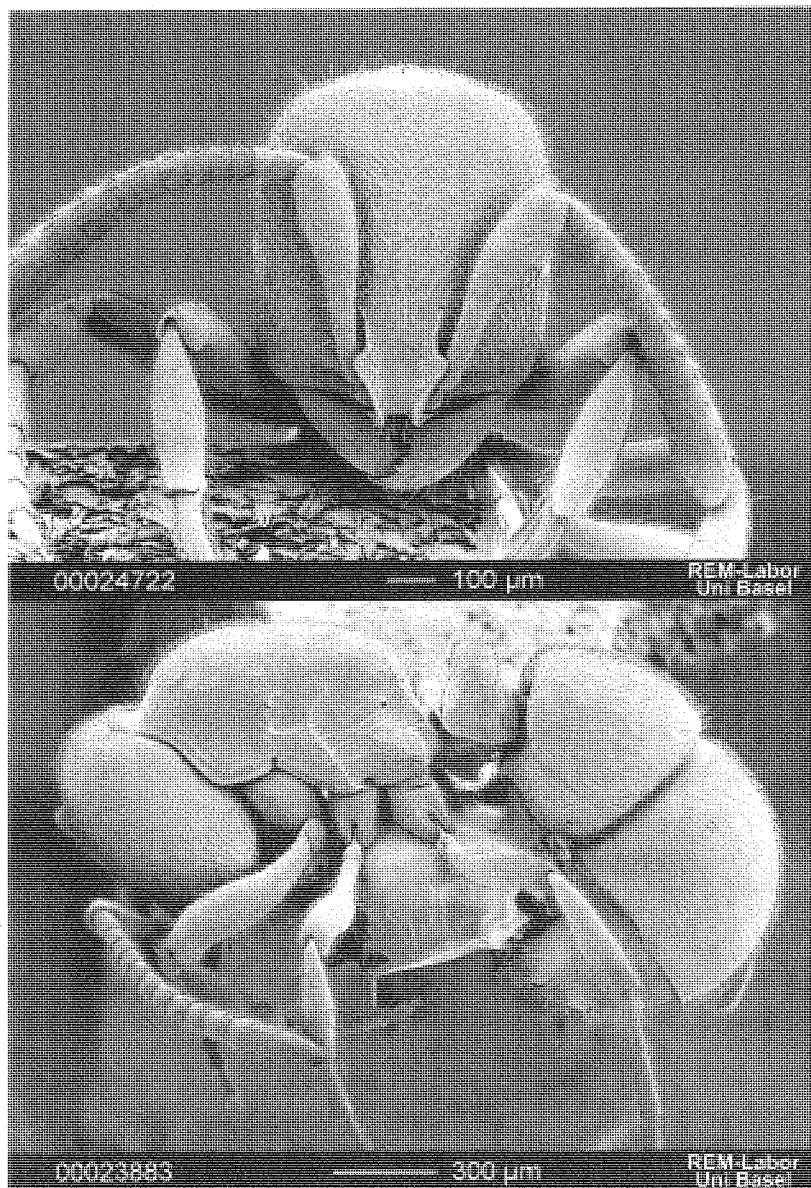


Fig. 139 – *Proceratium gracile* de Andrade. Worker (paratype) from Mountain Cordeaux, Queensland, Australia: head (top) in dorsal view and meso- and metasoma (bottom) in side view.

external border of a superficial sulcus. Eyes absent. First funicular joint about as broad as long. Funicular joints 2-10 broader than long. Last funicular joint as long as the sum of joints 6-10. Scapes short of the vertexal margin and gently thickening apically. Masticatory margin of the mandibles with 5-6 denticles before the pointed apical tooth. Palp formula 2,2.

Mesosoma gently convex and slightly shorter than maximum head length (mandibles included) in profile. Pronotal and propodeal sutures absent. Basal face of the propodeum gently declivous posteriorly. Area between the basal and declivous faces of the propodeum with a dorsal, faint, transversal carina. Each side between the basal and declivous faces of the propodeum subangulate. Declivous face of the propodeum flat. Sides of the declivous face of the propodeum slightly marginate. Propodeal spiracle round and above mid height in lateral view.

Petiole subrectangular and not very thick. Anterior border of the petiole straight and weakly carinate anterolaterally. Ventral process of the petiole large, subtriangular and pointed posteriorly. Postpetiole about 1/4 shorter than gastral tergite I. Postpetiole in dorsal view with convex sides. Postpetiolar sternite anteromedially with a marked subtriangular projection, gently convex posteriorly in profile. Constriction between postpetiole and gaster impressed. Gastral tergite I convex on the curvature, strongly convex after the postpetiolar constriction in dorsal view. Remaining gastral tergites and sternites curved ventrally.

Legs not very elongate. All tibiae with a pectinate spur. Spurs of fore legs without basal spine. Fore basitarsi longer than the mid ones. Hind basitarsi about 1/6 shorter than hind tibiae. Second tarsomere of hind legs shorter than pretarsus. Pretarsal claws simple. Arolia absent.

Sculpture. Head reticulate-punctate rugulose. Mesosoma, petiole, postpetiole, gaster and legs superficially shining, minutely punctate to weakly granulate, the granulation less marked on the gaster.

Body covered by hairs of three main types: (1) short, dense, suberect or subdecumbent on the whole body, slightly longer on the gaster, sparser and erect on the funicular joints; (2) longer than type (1), erect and relatively sparse on the whole body, absent on the funiculi; (3) shorter than hair type (1), dense and decumbent on the funicular joints only. In addition the funicular joints bear whitish, thick, appressed, sparse hairs.

Colour. Light ferruginous-brown with slightly lighter legs.

Measurements in mm and Indices: TL 2.98-3.27; HL 0.71-0.74; HW 0.65-0.68; EL absent; SL 0.49-0.52; WL 0.85-0.90; PeL 0.21-0.22; PeW 0.32-0.35; HFeL 0.52-0.56; HTiL 0.43-0.46; HBaL 0.36-0.40; LS4 0.30-0.35; LT4 0.61-0.72; CI 91.5-91.9; SI 69.0-70.1; IGR 0.48-0.49.

MATERIAL EXAMINED: AUSTRALIA: QUEENSLAND: Mount Cordeaux, Gunning Hams, Gap, 3000', I.V.1962, rotten wood forest floor, rainforest, 6 workers (holotype and paratypes), R. W. Taylor [ANIC].

DISCUSSION. *P. gracile* resembles *robustum* but the characters mentioned in the diagnosis allow an easy distinction of the two species.

DISTRIBUTION: Australia (Queensland).

### ***Proceratium robustum* de Andrade n. sp.**

Fig. 140

TYPE MATERIAL: holotype worker from New South Wales, Australia, labelled: "NSW. Dorrigo N. P., Glade, 2700 ft., rainforest, 12.ii.1968, R. W. Taylor, ex rotting log, ANIC Ants Vial 35-130", in ANIC; 3 paratype workers, same data and collection as the holotype.

DERIVATIO NOMINIS: from the Latin *robustus* (= robust, sturdy), referred to stout body of this species.

DIAGNOSIS. A *Proceratium* species belonging to the *silaceum* clade and resembling *gracile* but differing from it, in the worker, by the following characters: hind tarsomere shorter, CI > 94 instead of < 93, SI < 65 instead of ≥ 69 and hairs of type (2) longer and denser.

DESCRIPTION. *Worker* (Fig. 140). Head almost as long as broad, with gently convex sides. Vertex in full face view weakly convex. Clypeus re-

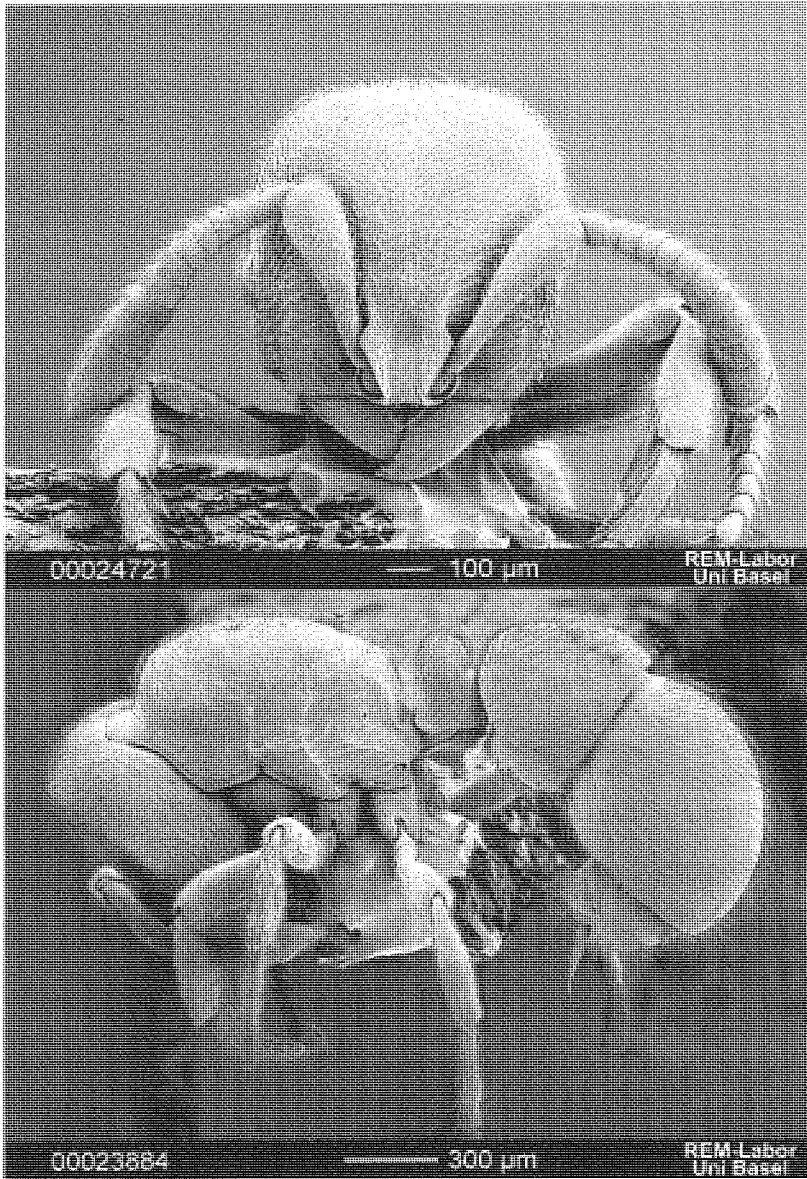


Fig. 140 – *Proceratium robustum* de Andrade. Worker (paratype) from Dorrigo National Park, Glade, New South Wales, Australia: head (top) in dorsal view and meso- and metasoma (bottom) in side view.

duced and as long as the antennal sockets. Anterior border of the clypeus truncate. Frontal carinae broad and badly covering the antennal insertions. Lateral expansions of the frontal carinae broad, raised, diverging on the two anterior thirds, converging and carinate only on the posterior third. Frontal area concave and with a longitudinal carina prolonging posteriorly. Head anterolaterally with a short, longitudinal carina. Genal carinae marked, each carina corresponding to the external border of a sulcus. Eyes visible as a dark dot below the integument, small and placed on the middle of the head sides. First funicular joint about as broad as long. Funicular joints 2-10 broader than long. Last funicular joint as long as the sum of joints 6-10. Scapes short of the vertexal margin and gently thickening apically. Masticatory margin of the mandibles with 8-9 denticles before the pointed apical tooth. Palp formula 2,2.

Mesosoma gently convex and slightly shorter than maximum head length (mandibles included) in profile. Pronotal and propodeal sutures absent. Basal face of the propodeum declivous posteriorly. Area between the basal and declivous faces of the propodeum dorsally gently concave, the concavity superficially carinate, the carina ending on each side in an angle. Declivous face of the propodeum flat. Sides of the declivous face of the propodeum slightly marginate. Propodeal spiracle round and above mid height in lateral view.

Petiole subrectangular and not very thick. Anterior border of the petiole straight and anterolaterally weakly carinate. Ventral process of the petiole large, subtriangular and pointed posteriorly. Postpetiole slightly shorter than 1/3 of the gastral tergite I, with convex sides in dorsal view. Postpetiolar sternite anteromedially with a marked subtriangular projection, gently convex posteriorly in side view. Constriction between postpetiole and gaster impressed. Gastral tergite I convex on the curvature. Remaining gastral tergites and sternites curved ventrally.

Legs not very elongate. All tibiae with a pectinate spur. Spurs of fore legs without basal spine. Fore basitarsi longer than the mid ones. Hind basitarsi about 1/4 shorter than hind tibiae. Second tarsomere of hind legs slightly shorter than pretarsus. Pretarsal claws simple. Arolia absent.

Sculpture. Head reticulate-punctate and rugulose, the rugosities more longitudinal on the sides. Mesosoma punctate and with short, transversal

rugosities on the middle of the mesonotum and of the propodeum. Petiole punctate, the punctures approaching granulation. Postpetiole, gaster and legs shining and with minute piligerous punctures.

Body covered by hairs of three main types: (1) short, dense, suberect or subdecumbent on the whole body, slightly longer on the postpetiole and gaster, sparser and erect on the funicular joints; (2) longer than type (1), sparse, subdecumbent on the head and mesosoma, decumbent or appressed on the petiole and postpetiole, subdecumbent or decumbent, denser on the gaster, absent on the antennae; (3) shorter than hair type (1), dense and decumbent on the funicular joints only. In addition the funicular joints bear whitish, thick, appressed, sparse hairs, and the scapes with sparse hairs similar to type (2).

Colour. Light brown with slightly lighter scapes and legs.

Measurements in mm and Indices: TL 3.12-3.19; HL 0.72; HW 0.69-0.70; EL 0.04-0.05; SL 0.45-0.46; WL 0.88; PeL 0.22-0.23; PeW 0.31-0.32; HFel 0.52-0.53; HTiL 0.42-0.46; HBaL 0.29-0.30; LS4 0.35-0.36; LT4 0.70; CI 95.8-97.2; SI 62.5-63.8; IGR 0.48-0.51.

*Gyne* (tentative attribution). Differing from the worker in the following details: eyes large, about 1/3 of the head length, composed by many facets and with ocular pilosity. Ocelli well developed.

Mesosoma robust and convex in side view. Parapsidal furrows marked. Scutellum with the sides gently convex and with the posterior border subtruncate. Dorsum of the scutellum with a longitudinal carina prolonging to the posterior half of the mesonotum. Metanotum with a small pointed tooth. Basal face of the propodeum medially slightly more concave and laterally denticulate.

Posterior half of the mesonotum and scutellum with irregular, longitudinal rugosities.

Measurements in mm and Indices: TL 3.48; HL 0.72; HW 0.70; EL 0.23; SL 0.46; WL 1.06; PeL 0.25; PeW 0.35; HFel 0.59; HTiL 0.46; HBaL 0.35; LS4 0.38; LT4 0.79; CI 97.2; SI 63.8; IGR 0.48.

MATERIAL EXAMINED: AUSTRALIA: NEW SOUTH WALES: Dorrigo National Park, Glade, 2700 ft., rainforest, 12.II.1968, 4 workers (holotype and paratypes), R. W. Taylor [ANIC]; Dorrigo National Park, E end Blackbutt

track, 710 m, 28.II-5.III.1980, under bark rotting log, subtropical rainforest, 1 gyne, A. Newton & M. Thayer [MCZC].

DISCUSSION. The isolated gyne attributed to this species, besides coming from the same area as the workers, shares with the workers the integumental sculpture and the hairs of type 2 decumbent or appressed on the petiole and gaster, instead of suberect as in the majority of the *Proceratium* species. The thick tarsi of both castes also strongly support this attribution.

DISTRIBUTION: Australia (New South Wales).

***Proceratium gigas* de Andrade n. sp.**

Fig. 141

TYPE MATERIAL: holotype worker (unique) from New South Wales, Australia, labelled: "NSW: Dorrigo NP, E end Blackbutt Track, 710 m, 28.II-5.III.1980, subtrop. rainf., A. Newton, M. Thayer", in MCZC.

DERIVATIO NOMINIS: From the Latin *gigas* (= giant), referred to large size of this species.

DIAGNOSIS. A *Proceratium* species belonging to the *silaceum* clade and differing from all the other species of the clade, in the worker, by the following combination of characters: CI = 83.9, frontal carinae broad and strongly diverging, petiolar node thick, and erect long hairs sparse.

DESCRIPTION. *Worker* (Fig. 141). Head longer than broad and with parallel sides. Vertex in full face view gently convex. Clypeus reduced and slightly longer than the antennal sockets. Anterior border of the clypeus truncate. Frontal carinae broad and slightly covering the antennal insertions. Lateral expansions of the frontal carinae broad, raised, diverging on the two anterior fourths, converging on the third fourth, diverging and carinate only on the posterior fourth. Frontal area concave on the three anterior fourths and with a longitudinal carina starting from the last fourth and prolonging posteriorly. Head anterolaterally with a short, longitudinal carina. Genal carinae distinct, each carina corresponding to the external border of a deep



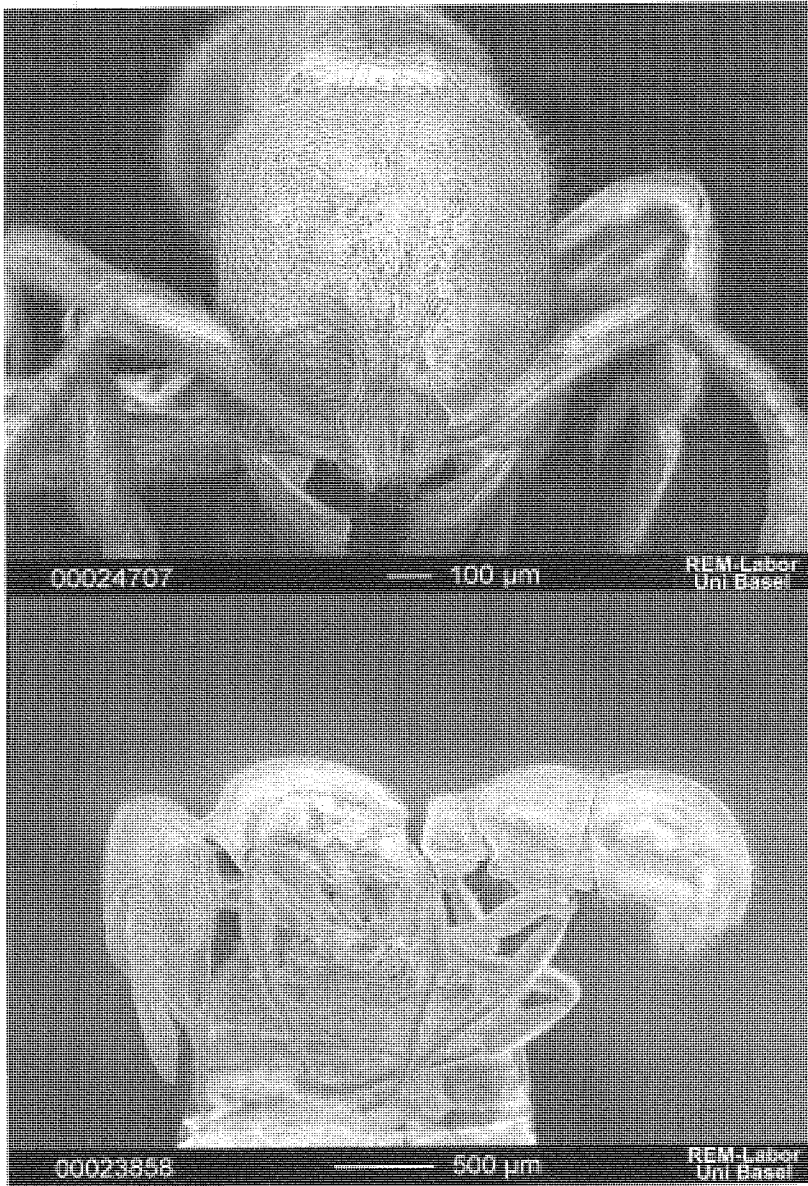


Fig. 141 – *Proceratium gigas* de Andrade. Worker (holotype) from Dorrigo National Park, New South Wales, Australia: head (top) in dorsal view and meso- and metasoma (bottom) in side view.

sulcus. Eyes visible as a dark dot below the integument, small and on the middle of the head sides. First funicular joint about as broad as long. Funicular joints 2-10 broader than long. Last funicular joint as long as the sum of joints 7-10. Scapes short of the vertexal margin and gently thickening apically. Right mandible with masticatory margin with 4 denticles before the pointed apical tooth and left mandible minutely crenulate and with preapical and apical teeth. Palp formula 2,2.

Mesosoma convex and about as long as the maximum head length (mandibles included) in profile. Pronotal and propodeal sutures absent. Basal face of the propodeum declivous posteriorly. Area between the basal and declivous faces of the propodeum gently concave medially and with a dorsal carina ending in a small tooth on each side. Declivous face of the propodeum flat. Sides of the declivous face of the propodeum slightly marginate. Propodeal spiracle round and above mid height in lateral view.

Petiole rectangular and thick. Anterior border of the petiole straight and anterolaterally carinate. Ventral process of the petiole large, subtriangular and slightly pointed posteriorly. Postpetiole about 1/3 shorter than gastral tergite I, with gently diverging sides in dorsal view. Postpetiolar sternite anteromedially with a marked subround projection, convex posteriorly in side view. Constriction between postpetiole and gaster impressed. Gastral tergite I convex on the curvature. Remaining gastral tergites and sternites curved ventrally.

Legs slightly elongate. All tibiae with a pectinate spur. Spurs of fore legs without basal spine. Fore basitarsi longer than the mid ones. Hind basitarsi about 1/5 shorter than hind tibiae. Second tarsomere of hind legs about as long as the pretarsus. Pretarsal claws simple. Arolia very small.

Sculpture. Head reticulate-punctate and rugulose. Mesosoma granulopunctate and with few, irregular rugosities, the rugosities more longitudinal on the pleurae. Petiole and postpetiole granulopunctate. Gaster and legs shining and with minute piligerous punctures, the punctures denser on the legs.

Body covered by hairs of three main types: (1) short, dense, suberect or subdecumbent on the whole body, sparser and erect on the funicular joints; (2) longer than type (1), sparse on the whole body, erect on the head and mesosoma, suberect or subdecumbent on the scapes, petiole, postpetiole,

gaster and legs, absent on the funiculi; (3) shorter than hair type (1), dense and decumbent on the funicular joints only. In addition the funicular joints bear whitish, thick, appressed, sparse hairs.

Colour. Light ferrugineous with slightly lighter antennae and legs.

Measurements in mm and Indices: TL 3.72; HL 0.87; HW 0.73; EL 0.04; SL 0.60; WL 1.04; PeL 0.25; PeW 0.35; HFeL 0.68; HTiL 0.56; HBaL 0.45; LS4 0.40; LT4 0.80; CI 83.9; SI 68.9; IGR 0.50.

MATERIAL EXAMINED: AUSTRALIA: NEW SOUTH WALES: Dorrigo National Park, E end Blackbutt Track, 710 m, 28.II-5.III.1980, subtropical rainforest, 1 worker (holotype), A. Newton & M. Thayer [MCZC].

DISCUSSION. *P. gigas* is the sole species of the *silaceum* clade with small CI values (83.9 instead of  $\geq 90$  as in the other species). *Gigas* shares with *hirsutum* the broad, diverging frontal carinae, but *gigas* has sparser and shorter hairs and denser body sculpture. Among the 6 species of the *silaceum* group known from Australia, *gigas* is the largest one as exemplified by its TL = 3.72 mm (TL  $\leq 3.62$  mm for the other 5 species).

*Gigas* resembles *gracile* and *robustum* for the shape of the gaster, strongly convex in profile.

DISTRIBUTION: Australia (New South Wales).

### ***Proceratium numidicum* Santschi**

Fig. 142

*Proceratium numidicum* Santschi, 1912: 172, figs. 1 (worker) & 2 (gyne). Worker and gyne. Original description. Type locality: Aïn Draham, Tunisia. Type material: 12 syntype workers and one syntype gyne partially labelled: "Tunisie, A. Draham, Dr. Normand, *Proceratium numidicum* Sants., type, in NHMB (10 workers and 1 gyne), USNM (1 worker), MCSN (1 worker)" examined.

*Proceratium normandi* Santschi, 1929. Worker and gyne. Original description. Type locality: El Kala, Tunisia. Type material: 5 syntype workers and one syntype gyne labelled: "C.-La Calle, Dr. Normand, *Proceratium normandi* Sants., Santschi det. 1929, in NHMB", examined. Synonymy with *numidicum* by Brown, 1974: 82.

*Sysphincta europaea* Forel, Finzi, 1923: 2. Misidentification.

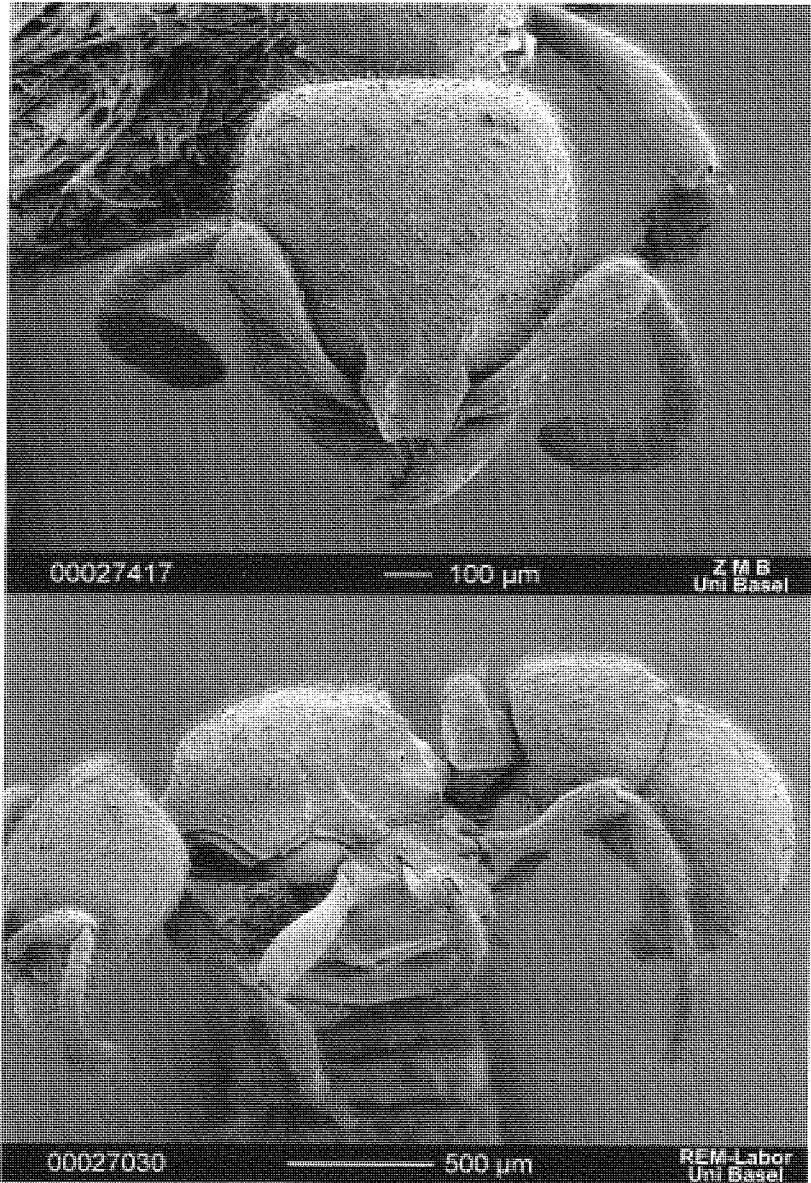


Fig. 142 – *Proceratium numidicum* Santschi. Worker (paratype) from Ain Draham, Tunisia: head (top) in dorsal view and meso- and metasoma (bottom) in side view.

*Proceratium normandi* Santschi, Brown, 1958a: 334.

*Proceratium numidicum* Santschi, Brown, 1974: 82.

*Proceratium numidicum* Santschi, Baroni Urbani, 1977: 93.

*Proceratium numidicum*, Brown, 1980: 343.

**DIAGNOSIS.** A *Proceratium* species belonging to the *silaceum* clade and resembling to *japonicum*, but differing from it, in the worker and gyne, by the broader frontal carinae, narrower petiole and more superficial sculpture.

**DESCRIPTION.** *Worker* (Fig. 142). Head almost as broad as long and with gently convex sides. Vertex in full face view weakly convex. Clypeus reduced and as long as the antennal socket. Anterior border of the clypeus truncate. Frontal carinae far from each other, partly covering the antennal insertions. Lateral expansions of the frontal carinae broad, little raised, strongly diverging on the two anterior fourths, converging on the third fourth, subparallel and carinate only on the last fourth. Frontal area gently concave on the three anterior fourths, with a central longitudinal carina starting from the last fourth and prolonging posteriorly. Head anterolaterally with a thick, short, longitudinal carina. Genal carinae marked, each carina corresponding to the external border of a deep sulcus. Eyes visible as a dark dot below the integument, small and on the middle of the head sides. First funicular joint slightly longer than broad. Funicular joints 2-10 broader than long. Last funicular joint as long as the sum of joints 7-10. Scapes short of the vertexal margin and gently thickening apically. Masticatory margin of the mandibles with 7-9 denticles before the pointed apical tooth. Palp formula 2,2.

Mesosoma in side view convex anteriorly, declivous posteriorly and shorter than maximum head length (mandibles included). Pronotal and propodeal sutures absent. Basal face of the propodeum declivous posteriorly. Declivous face of the propodeum flat. Area between basal and declivous faces of the propodeum concave, dorsally carinate and laterally with a small tooth. Sides of the declivous face of the propodeum carinate. Propodeal spiracle round and above mid height in lateral view.

Petiole subrectangular and slightly narrow. Anterior border of the petiole straight and anterolaterally carinate. Ventral process of the petiole lamella-ceous and directed backwards. Postpetiolar sternite anteromedially with a marked subtriangular projection, gently convex posteriorly in side view.

Constriction between postpetiole and gaster impressed. Gastral tergite I about 1/3 longer than the postpetiole and convex on the curvature. Posterior border of the gastral tergite I thick and irregular. Remaining gastral tergites and sternites curved ventrally.

Legs not very short. All tibiae with a pectinate spur. Spurs of fore legs without basal spine. Fore basitarsi longer than the mid ones. Hind basitarsi about 1/4 shorter than hind tibiae. Second tarsomere of hind legs shorter than pretarsus. Pretarsal claws simple. Arolia absent.

Sculpture. Head reticulate-punctate and rugulose; sides of the head with broad reticulation and rugosities. Mesosoma, petiole and postpetiole sparsely granulopunctate, this sculpture sparser and smaller on the anterior half of the mesosoma and on the center of the postpetiole; in addition the posterior half of the mesosoma with irregular, short rugosities. Gaster smooth and with minute piligerous punctures, the punctures denser on the sides. Legs punctate.

Body covered by hairs of three main types: (1) short, dense, suberect or subdecumbent on the whole body, suberect and sparse on the funicular joints; (2) longer than type (1), erect on the whole body, sparser on the scapes, absent on the funiculi; (3) shorter than hair type (1), dense and decumbent on the funicular joints only. In addition the funicular joints bear whitish, thick, appressed, sparse hairs.

Colour. Dark ferruginous-brown with slightly lighter antennae and legs. Some specimens with a dark brown macula on the posterior half of the head dorsum.

Measurements in mm and Indices: TL 3.03-3.29; HL 0.71-0.75; HW 0.69-0.72; EL 0.03-0.04; SL 0.46-0.48; WL 0.82-0.90; PeL 0.18-0.21; PeW 0.27-0.29; HFeL 0.52-0.56; HTiL 0.42-0.45; HBaL 0.32-0.36; LS4 0.39-0.40; LT4 0.68-0.72; CI 95.8-96.0; SI 63.9-64.8; IGR 0.54-0.58.

*Gyne*. Differing from the worker in the following details: eyes large, slightly more than 1/4 of the head length, composed by many facets and with ocular pilosity. Ocelli well developed.

Mesosoma robust and convex in side view. Parapsidal furrows marked. Scutellum with the sides gently convex and with the posterior border subtruncate. Dorsum of the scutellum with a longitudinal carina prolonging to the posterior half of the mesonotum. Metanotum with a pointed tooth. Basal

face of the propodeum medially concave. Area between basal and declivous faces of the propodeum carinate and with a small tooth on each side.

Head sculpture more impressed and larger. Postpetiole reticulate.

Measurements in mm and Indices: TL 3.98-4.08; HL 0.79-0.82; HW 0.81-0.83; EL 0.23-0.24; SL 0.52-0.54; WL 1.10-1.16; PeL 0.23-0.27; PeW 0.36-0.40; HFeL 0.68-0.70; HTiL 0.52-0.55; HBaL 0.44-0.45; LS4 0.49-0.55; LT4 0.88-0.96; CI 101.2-102.5; SI 65.0-65.8; IGR 0.55-0.57.

MATERIAL EXAMINED: TUNISIA: Ain Draham, 12 workers (syntypes), 1 gyne (syntype), Normand [NHMB, MCSN, USNM]; same locality and collector, 2 workers (probably nidotypes) [LACM, NHMB]; Le Kef, 1 worker (wrongly labelled as cotype of *numidicum*), [MHNG]. ALGERIA: La Calle (today El Kala), 5 workers (syntypes of *normandi*), 1 gyne (syntype of *normandi*), Normand [NHMB]. ALBANIA: Tirana, 1 worker, Ravasini & Lona [MCZC]. CYPRUS: 600 m Alonoudhi junction, 15.VII.1977, 1 gyne, C. Besuchet [MHNG].

DISCUSSION. *P. numidicum* resembles *japonicum* in general body shape but it can easily be distinguished from it by the characters already given in the diagnosis.

This species was previously known from Tunisia and Algeria only. After Brown (1958a) reported a specimen from Albania, Baroni Urbani (1977) warned that the same specimen was already identified and published by Finzi (1923) as *S. europaea* (= *P. melinum*), i. e. the commonest Balkan species and that this appeared to be the most plausible identification. Brown (1980) corroborates his (1958a) identification, an identification that we confirm after examination of the specimen in question. The presence of *P. numidicum* in SE Europe, now, appears less intriguing due to its report from Turkey (Baroni Urbani, 1977) and from Cyprus (present paper).

DISTRIBUTION: Tunisia, Algeria, Turkey, Cyprus and Albania.

**Proceratium japonicum** Santschi

Figs. 143, 144, 145

*Proceratium japonicum* Santschi, 1937: 362, fig. 1. Worker. Original description. Type locality: Honshu, Japan. Type material: 3 syntype workers labelled: "Japon, Oshima, Iya, Honshiu, 10.VI.28, Kisato, *Proceratium japonicum* Sant., Dr. Santschi F. 1937", in NHMB, examined.

*Proceratium japonicum* Santschi, Onoyama & Ogata, 1987: 106, figs. 15-16 (worker), 19 (wings).

*Proceratium japonicum* Santschi, Onoyama & Ogata, 1989: 15, figs. 3.23 a, 3.24, worker.

*Proceratium formosicola* Terayama, 1985: 406, figs. 1-4, worker and gyne. Worker. Original description. Type locality: Taiwan. Type material: 1 paratype worker labelled: 15.VI.II.1980, Lushan (ca. 1000 m Alt.), Nantou Hsien, Taiwan, M. Terayama leg., Paratype, *Proceratium formosicola*, Terayama, 1985, in MTCS, examined. Synonymy with *japonicum* by Onoyama, 1991: 695.

*Proceratium japonicum* (Wheeler), JADG, 1998: figs. PCD1328-07, PCD1328-08, PCD1328-09, 103023a, 103024. Worker.

*Proceratium japonicum* Santschi, Onoyama & Yoshimura, 2002: 38, figs 2, 10-12, 48, 55 (worker), 22-24, 49, 69-70 (gyne), 4-6, 35-38, 71-72 (male), 60 (male genitalia).

**DIAGNOSIS.** A *Proceratium* species belonging to the *silaceum* clade and resembling *numidicum*, but differing from it, in the worker and gyne, by the narrower frontal carinae, by broader petiole and by the more impressed body sculpture.

**DESCRIPTION.** *Worker* (Fig. 143). Head slightly longer than broad and with weakly convex sides. Vertex in full face view gently convex. Clypeus reduced, slightly surpassing the antennal sockets. Anterior border of the clypeus truncate. Frontal carinae far from each other, slightly covering the antennal insertions. Lateral expansions of the frontal carinae little raised, diverging on the two anterior fourths, converging on the third fourth, subparallel and carinate only on the last fourth. Frontal area gently concave on the three anterior fourths and with a central longitudinal carina starting from the last fourth and prolonging posteriorly. Head anterolaterally with a thick, short, longitudinal carina. Genal carinae distinct, each carina corresponding to the external border of a deep sulcus. Eyes visible as a dark dot below the integument, small and on the middle of the head sides. First funicular joint slightly longer than broad. Funicular joints 2-10 broader than long. Last funicular joint as long as the sum of joints 7-10. Scapes short of the vertexal



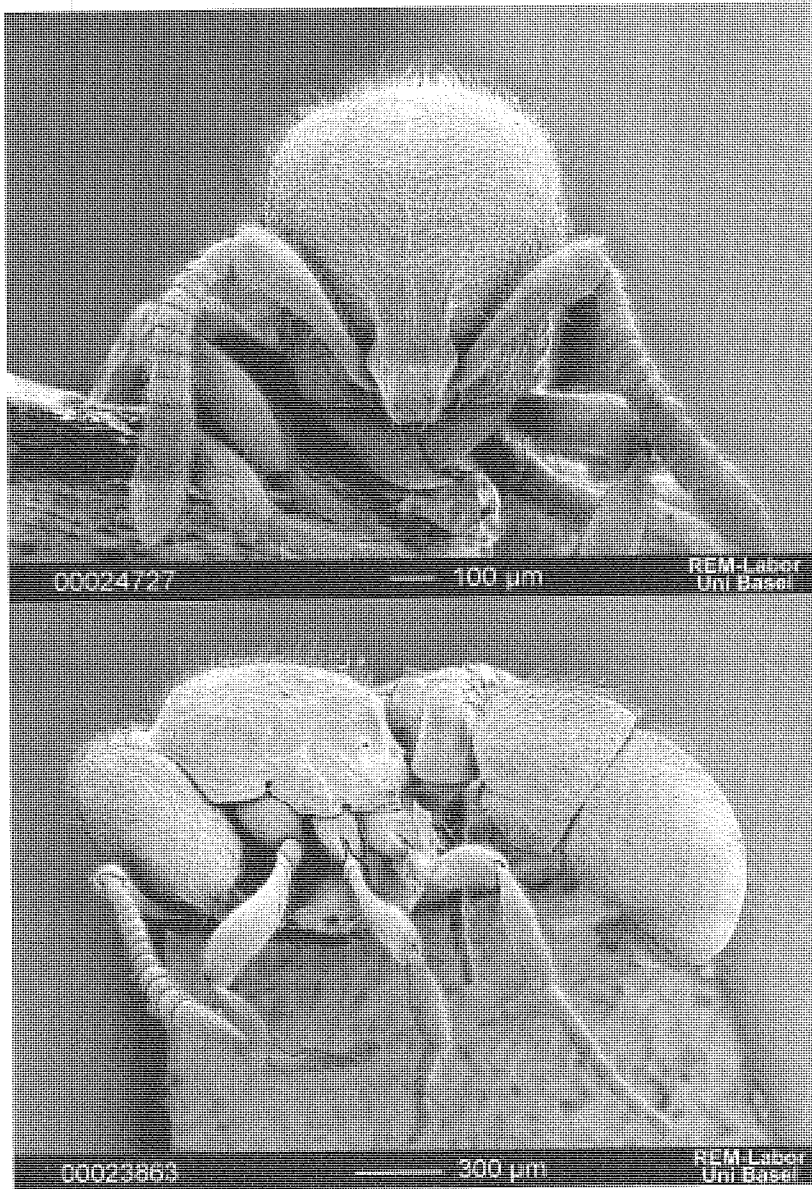


Fig. 143 – *Proceratium japonicum* Santschi. Worker from Odawara, Kanagawa, Japan: head (top) in dorsal view and meso- and metasoma (bottom) in side view.

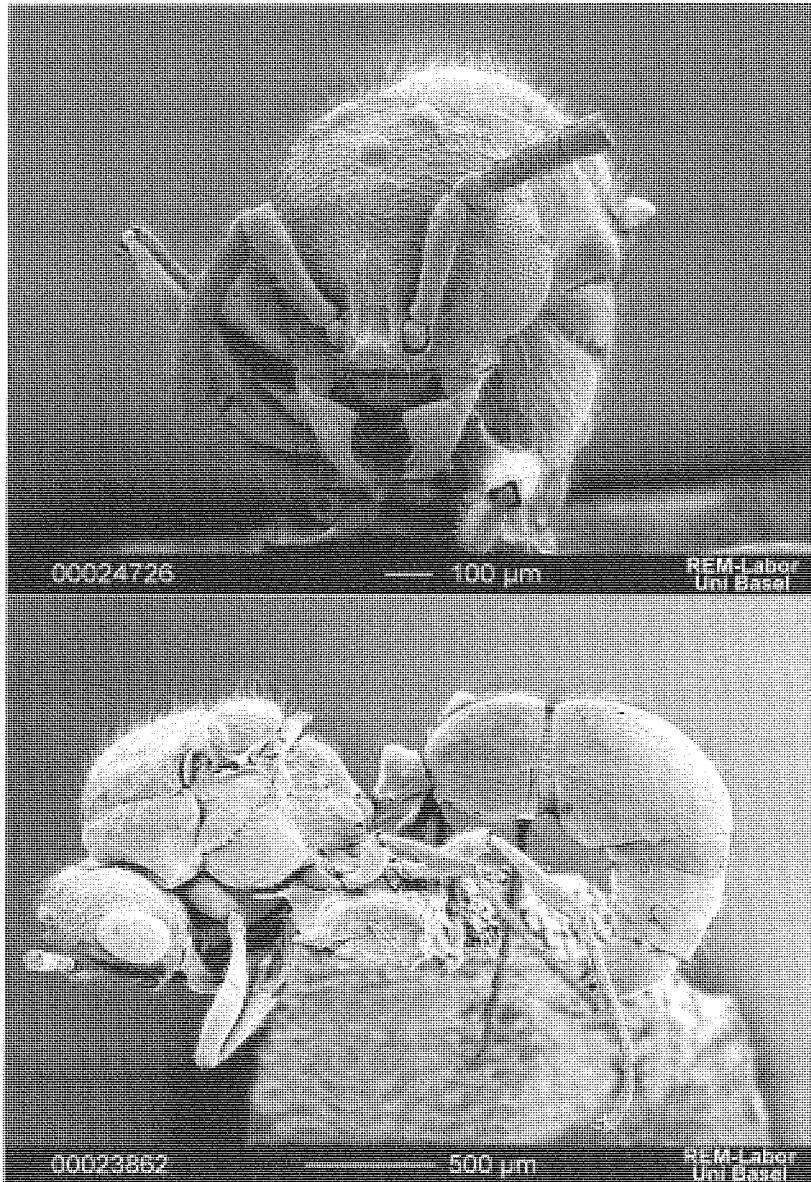


Fig. 144 – *Proceratium japonicum* Santschi. Male from Odawara, Kanagawa, Japan: head (top) in dorsal view and meso- and metasoma (bottom) in side view.

margin and gently thickening apically. Masticatory margin of the mandibles with 9-11 denticles before the pointed apical tooth. Palp formula 2,2.

Mesosoma in profile convex anteriorly, declivous posteriorly and shorter than the maximum head length (mandibles included). Pronotal and propodeal sutures absent. Basal face of the propodeum declivous posteriorly. Declivous face of the propodeum flat. Area between basal and declivous faces of the propodeum gently concave, less carinate dorsally than in *numidicum* and laterally angulate or denticulate. Sides of the declivous face of the propodeum carinate. Propodeal spiracle round and above mid height in lateral view.

Petiole subrectangular, broader than in *numidicum*. Anterior border of the petiole straight and anterolaterally carinate. Posterior broader of the petiolar node gently convex or subangulate. Ventral process of the petiole lamelliform and directed backwards. Postpetiolar sternite anteromedially with a marked subtriangular projection, gently convex posteriorly in side view. Constriction between postpetiole and gaster impressed. Gastral tergite I about 1/3 longer than the postpetiole and convex on the curvature. Remaining gastral tergites and sternites curved ventrally.

Legs not very short. All tibiae with a pectinate spur. Spurs of fore legs without basal spine. Fore basitarsi longer than the mid ones. Hind basitarsi about 1/4 shorter than hind tibiae. Second tarsomere of hind legs shorter than pretarsus. Pretarsal claws simple. Arolia absent.

Sculpture. Head reticulate-punctate and rugulose, the reticulation and the rugosities broader on the sides. Mesosoma, petiole and postpetiole punctate, the punctures smaller on the anterior half of the mesosoma. Posterior half of the mesosoma and sides of the postpetiole with additional, irregular reticulation. Gaster smooth and with minutely piligerous punctures, the punctures denser and mixed with superficial reticulation on the sides. Legs punctate.

Body covered by hairs of three main types: (1) short, dense, suberect or subdecumbent on the whole body, sparse on the funicular joints; (2) longer than type (1), erect on the whole body, absent on the funiculi; (3) shorter than hair type (1), dense and decumbent on the funicular joints only. In addition the funicular joints bear whitish, thick, appressed, sparse hairs, and the scapes with sparse hairs similar to type (2) but slightly shorter.

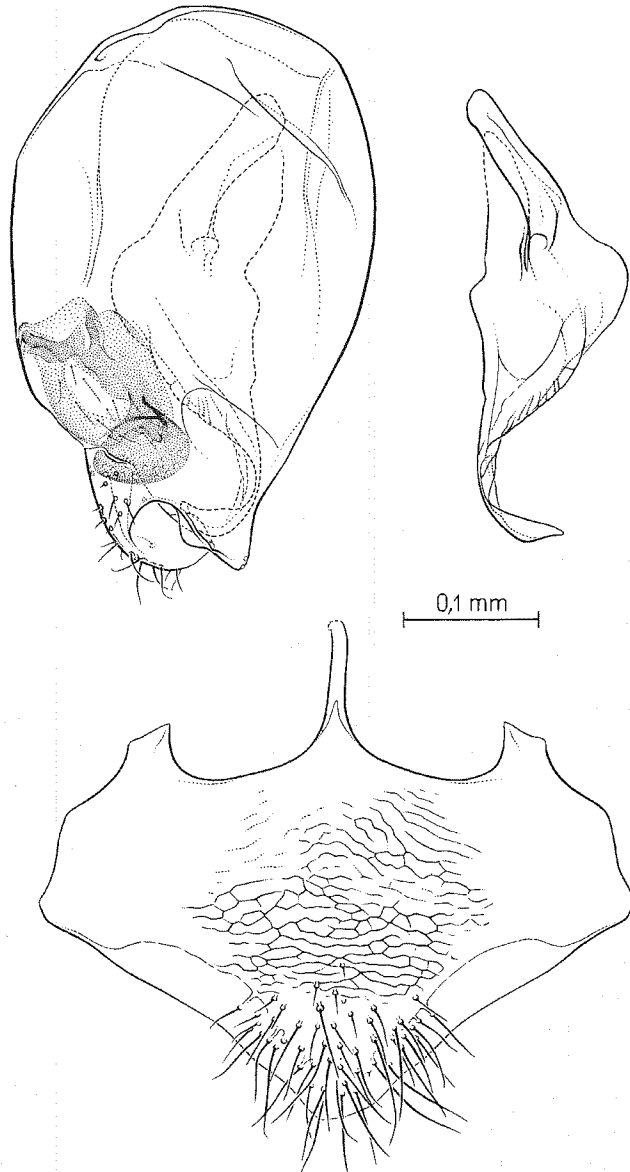


Fig. 145 – *Proceratium japonicum* Santschi. Male from Odawara, Kanagawa, Japan. Genital appendages: a) lateral view of left parameres and of their relative positions; b) right aedeagus in profile; c) subgenital plate in ventral view.

Colour. Yellow to brown with slightly lighter antennae and legs. Some specimens have the posterior half of the head dorsum darker.

Measurements in mm and Indices: TL 2.84-3.32; HL 0.63-0.75; HW 0.59-0.71; EL 0.03-0.07; SL 0.42-0.49; WL 0.78-0.91; PeL 0.19-0.24; PeW 0.30-0.35; HFeL 0.47-0.56; HTiL 0.38-0.46; HBaL 0.29-0.34; LS4 0.33-0.41; LT4 0.65-0.75; CI 93.6-94.7; SI 64.6-66.6; IGR 0.51-0.55.

*Gyne*. Differing from the worker in the following details: eyes large, 1/4 of the head length, composed by many facets and with ocular pilosity. Ocelli well developed.

Mesosoma robust and convex in side view. Parapsidal furrows marked. Scutellum with the sides gently converging posteriorly and with the posterior border round. Dorsum of the scutellum with a longitudinal carina prolonging to the posterior half of the mesonotum. Metanotum with a pointed tooth. Basal face of the propodeum medially concave. Area between basal and declivous faces of the propodeum carinate and with a small tooth on each side.

Fore wings of our type 4, hind wings of our type 2 and 3 as defined in the description of the genus.

Measurements in mm and Indices: TL 3.48-3.75; HL 0.69-0.73; HW 0.67-0.72; EL 0.19-0.24; SL 0.47-0.49; WL 0.98-1.10; PeL 0.24-0.26; PeW 0.38-0.40; HFeL 0.58-0.60; HTiL 0.47-0.48; HBaL 0.38-0.39; LS4 0.46; LT4 0.84-0.86; CI 97.1-98.6; SI 67.1-68.1; IGR 0.53-0.55.

*Male* (Fig. 144). Head as broad as long or slightly broader than long. Vertex in full face view convex. Vertexal margin carinate. Clypeus dorsally variably convex and with subround or straight anterior border. Frontal carinae thin, low and parallel. Frontal area concave; postero-lateral borders of the concavity variably marginate, the margins converging posteriorly and connected to a longitudinal carina. Ocelli large. Compound eyes large and situated mostly on the anterior part of the head sides. Scapes not reaching the anterior ocellus. First funicular joint about as broad as long and 1/3 shorter than the second joint. Joints 2-12 longer than broad. Last funicular joint slightly longer than the sum of joints 10-11. Mandibles edentate and only with a pointed apical tooth. Palp formula 5,2.

Mesosoma robust. Pronotum and anterior third of mesonotum almost perpendicular to the posterior two thirds of the mesonotum. Posterior two thirds of mesonotum almost flat. Parapsidal furrows marked. Scutellum as high as the mesonotum; sides of the scutellum converging into a round posterior border. Basal and declivous propodeal faces slightly convex in side view. Basal face of the propodeum slightly declivous posteriorly. Declivous face of the propodeum flat. Area between basal and declivous faces of the propodeum gently concave and laterally subangulate. Declivous face of propodeum laterally superficially carinate. Metanotum with a median lamellaceous tooth. Propodeal lobes round and lamellaceous. Propodeal spiracles small.

Petiole in side view sloping anteriorly in the two anterior fourths, subconvex in the third fourth and sloping in the posterior fourth. Sides of the petiole in dorsal view weakly convex. Anterior border of the petiole straight and laterally carinate. Subpetiolar process very small and subtriangular. Postpetiole anteriorly broader than the petiole; postpetiolar sides diverging posteriorly. Anterior border of the postpetiolar sternite with a superficial triangular "lip". Gastral tergite I in side view convex. Gastral sternite I large. Remaining gastral tergites and sternites slightly curved ventrally.

Legs as in the worker but more elongate. Hind basitarsi slightly shorter than hind tibiae.

Fore wings of our type 4, hind wings of our type 2 and 3 as defined in the description of the genus.

Genitalia as in Fig. 145.

Sculpture. Head and mesosoma punctate, reticulorugose, the reticulation large on the mesonotum and larger than on mesonotum on the basal face of the propodeum and metapleurae. Petiole, postpetiole, gaster and legs smooth and with minute piligerous punctures slightly denser on the postpetiole.

Body covered by hairs of three main types: (1) short, dense, suberect or subdecumbent, suberect, sparse and slightly shorter on the funicular joints; (2) longer than type (1), erect or subdecumbent, slightly longer on the gaster, absent on the antennae; (3) shorter than hair type (1), dense and decumbent on the funicular joints. In addition the funicular joints bear whitish, thick, appressed, sparse hairs, and the scapes with sparse hairs similar to type (2) but slightly shorter.

Colour. Dark brown-black with lighter mandibles, antennae and legs.

Measurements in mm and Indices: TL 2.52-3.19; HL 0.48-0.58; HW 0.50-0.58; EL 0.26-0.28; SL 0.23-0.28; WL 0.84-1.08; PeL 0.19-0.21; PeW 0.21-0.25; HFeL 0.48-0.62; HTiL 0.38-0.48; HBaL 0.32-0.46; LS4 0.32-0.44; LT4 0.58-0.72; CI 100.0-104.2; SI 47.9-49.1; IGR 0.55-0.59.

MATERIAL EXAMINED: JAPAN: Oshima Iya, 10.VI.1928, 3 workers (syn-types), Kisato [NHMB]. NARA: Nara, 23-31.VII.1980, 1 worker, C. Besuchet [MHNG]. KANAGAWA: Odawara, 15.IX.1985, 9 workers, 3 males, H. Sakai [LACM]; Manazuru, 20.X.1968, 2 workers, M. Kubota [MCZC]; same locality, 8.I.1978, 1 worker, M. Kubota [NHMB]. RYUKYU ISLANDS: Iriomote, 5.X.1992, 1 worker, D. Fresnau [CPCC]; Ishigaki, 1.IV.1975, 1 worker, M. Tanaka [NHMB]; Mt. Otowadake, 240 m, 8.VII.2001, 1 worker, 1 gyne, 2 males, K. Onoyama [NHMB]. TAIWAN: Lushan, Nantou Hsien, 15.VIII.1980, ca. 1000 m, 1 worker (paratype of *formosicola*), M. Terayama [MTCS]; Urai, 1.IV.1932, 1 gyne, L. Gressitt [LACM].

DISCUSSION. As already noticed by Onoyama & Yoshimura (2002) the specimens from the Ryukyu Islands are smaller than those from Honshu; the single worker from Taiwan we examined is somewhat intermediate.

DISTRIBUTION: Japan and Taiwan.

***Proceratium angulinode* de Andrade n. sp.**

Fig. 146

TYPE MATERIAL: holotype worker (unique) from Malaysia labelled: "Sarawak: 4<sup>th</sup> Division Gn. Mulu NP, P. M. Hammond & J. E. Marshall, v-viii.1978, B. M. 1978-49", in BMNH.

DERIVATIO NOMINIS: from the Latin *angulus* (= angle) and *nodus* (= pedicel), referred to the postpetiole, anterolaterally angulate.

DIAGNOSIS. A *Proceratium* species belonging to the *silaceum* clade and differing from its sister species, *striativenter*, in the worker, by the broader frontal carinae, by the SI < 65 instead of  $\geq 75.6$ , by the gaster with thinner and shorter longitudinal rugosities and by the TL < 2.9 mm instead of > 3.3 mm.

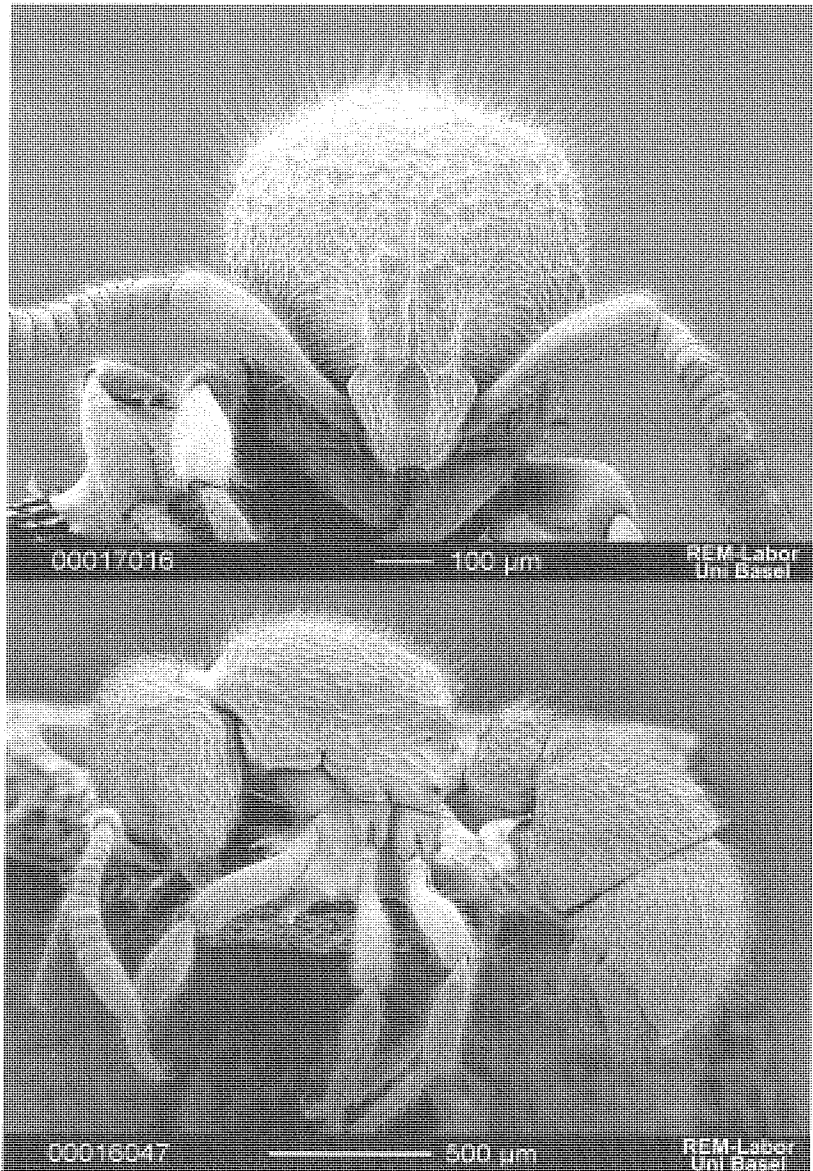


Fig. 146 – *Proceratium angulinode* de Andrade. Worker from confluence Suan Oyan and Mujong rivers, E Kapit, Sarawak: head (top) in dorsal view and meso- and metasoma (bottom) in side view.



DESCRIPTION. *Worker* (Fig. 146). Head about as broad as long and with the sides gently diverging posteriorly. Vertex in full face view gently convex. Clypeus reduced and slightly surpassing the antennal sockets. Anterior border of the clypeus truncate. Frontal carinae far from each other, partially covering the antennal insertions. Lateral expansions of the frontal carinae broad, little raised, strongly diverging on the anterior one-half, converging on the third fourth, parallel and carinate only on the last fourth. Frontal area gently concave on the three anterior fourths and with a central, thick longitudinal carina starting from the last fourth and prolonging posteriorly. Head anterolaterally with a thick, short, longitudinal carina. Genal carinae marked, each carina corresponding to the external border of a deep sulcus. Eyes visible as a small dark dot below the integument, on the middle of the head sides. First funicular joint about as long as broad. Funicular joints 2-10 broader than long. Last funicular joint as long as the sum of joints 6-10. Scapes short of the vertexal margin and gently thickening apically. Masticatory margin of the mandibles with 6-7 denticles before the pointed apical tooth. Palp formula 2,2.

Mesosoma in side view gently convex and about as long as the maximum head length (mandibles included). Pronotal and propodeal sutures absent. Basal face of the propodeum declivous posteriorly. Declivous face of the propodeum flat. Area between the basal and declivous faces of the propodeum weakly concave, irregularly marginate, the margin forming a triangular denticle or an angle laterally. Sides of the declivous face of the propodeum marginate. Propodeal spiracle round and above mid height in lateral view.

Petiole subrectangular and thick. Anterior border of the petiole straight and anterolaterally carinate. Ventral process of the petiole large, stout and triangular. Anterior face of the postpetiole concave and laterally strongly angulate. Postpetiolar sternite anteromedially with a marked subtriangular projection, gently convex posteriorly in side view. Constriction between postpetiole and gaster impressed. Gastral tergite I about 1/4 longer than the postpetiole and convex on the curvature. Gastral tergite I with a thick, irregular, transversal border before the posterior margin, the border almost as long as the posterior margin. Remaining gastral tergites and sternites curved ventrally.

Legs short. All tibiae with a pectinate spur. Spurs of fore legs without basal spine. Fore basitarsi longer than the mid ones. Hind basitarsi about 1/3 shorter than hind tibiae. Second tarsomere of hind legs slightly shorter than pretarsus. Pretarsal claws simple. Arolia absent.

Sculpture. Head, mesosoma, petiole, postpetiole and gaster with variably distributed, irregular, foveae-like impressions, granulopunctate and irregularly rugulose. The granules less raised and the rugosities slightly longitudinal on the gaster. Legs punctate.

Body covered by hairs of three main types: (1) short, dense, suberect or subdecumbent on the whole body, sparse on the funicular joints; (2) longer than type (1), erect on the whole body, slightly shorter on the scapes, absent on the funiculi; (3) shorter than hair type (1), dense and decumbent on the funicular joints. In addition the funicular joints bear whitish, thick, appressed, sparse hairs.

Colour. Dark ferruginous-brown with lighter antennae and legs.

Measurements in mm and Indices: TL 2.76-2.85; HL 0.62-0.65; HW 0.62-0.66; EL 0.04; SL 0.40-0.41; WL 0.80-0.84; PeL 0.22; PeW 0.33-0.34; HFeL 0.45-0.47; HTiL 0.38-0.39; HBaL 0.26; LS4 0.24-0.25; LT4 0.55-0.57; CI 100.0-101.5; SI 63.1-64.5; IGR 0.44.

MATERIAL EXAMINED: MALAYSIA: SARAWAK: 4<sup>th</sup> Division Gunung Mulu National Park, 5.VIII.1978, 1 worker (holotype), P. M. Hammond & J. E. Marshall [BMNH]; confluence Suan Oyan and Mujong rivers, E Kapit, 150 m, 19.V.1994, 2 workers, Löbl & Burckhardt [MHNG].

DISCUSSION. *P. angulinode* and *striativenter* are very distinctive among the species of the *silaceum* clade. Both species share by synapomorphy the postpetiole anterolaterally angulate and the first gastral tergite with a transversal integumental folding before the posterior margin.

DISTRIBUTION: Malaysia (Sarawak).

**Proceratium striativenter** de Andrade n. sp.

Figs. 3, 147

TYPE MATERIAL: holotype worker (unique) from Malaysia labelled: "SARAWAK, Mt. Santubong nr. Kuching, rainforest, 5.VI.1968, leafmould berlesate, c. 1800 ft., G. Rothschild, acc.68.294", in ANIC.

DERIVATIO NOMINIS: from the Latin *stria* (= stripe, furrow) and *venter* (= belly, gaster), referred to the integumental structure of the gaster of this species.

DIAGNOSIS. A *Proceratium* species belonging to the *silaceum* clade and differing from its sister species, *angulinode*, in the worker, by the frontal carinae narrower, by the gaster completely covered by thicker, more regular, longitudinal rugosities, by the  $SI \geq 75.6$  instead of  $< 65$  and by the  $TL > 3.3$  mm instead of  $< 2.9$  mm.

DESCRIPTION. *Worker* (Figs. 3 & 147). Head as long as broad and with the sides gently diverging posteriorly. Vertex in full face view gently convex. Clypeus reduced and about as long as the antennal sockets. Anterior border of the clypeus truncate. Frontal carinae less broad than in *angulinode*, slightly covering the antennal insertions. Lateral expansions of the frontal carinae narrower than in *angulinode*, more raised than in *angulinode*, diverging on the anterior one-half, converging on the third fourth, parallel and carinate only on the last fourth. Frontal area gently concave on the second and third fourths and with a central, thick longitudinal carina starting from the last fourth and prolonging posteriorly. Head anterolaterally with a thick, short, longitudinal carina. Genal carinae marked, each carina corresponding to the external border of a deep sulcus. Eyes represented by a dark dot below the integument, small and placed on the middle of the head sides. First funicular joint slightly longer than broad. Funicular joints 2-10 broader than long. Last funicular joint as long as the sum of joints 6-10. Scapes short of the vertexal margin and gently thickening apically. Masticatory margin of the mandibles with 7-8 denticles before the pointed apical tooth. Palp formula 2,2.

Mesosoma in side view convex and about as long as the maximum head length (mandibles included). Pronotal and propodeal sutures absent. Basal face of the propodeum declivous posteriorly. Declivous face of the

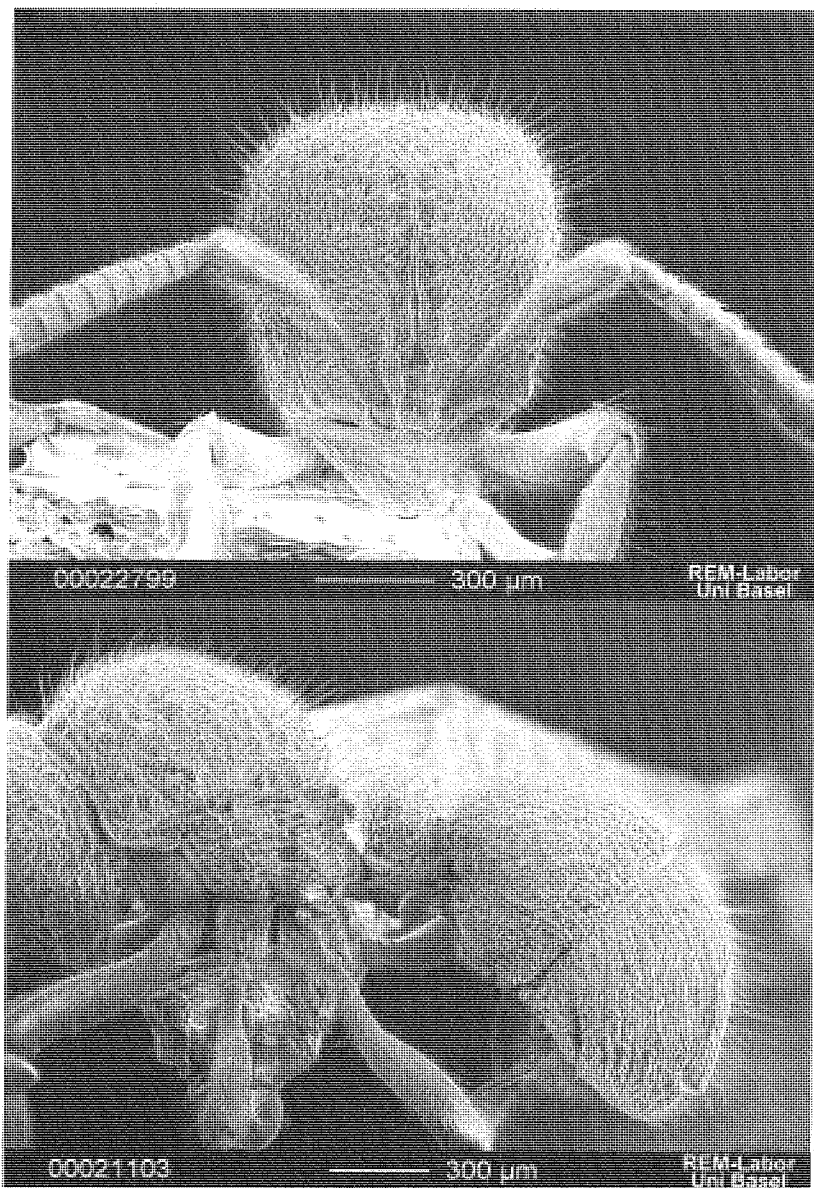


Fig. 147 – *Proceratium striativenter* de Andrade. Worker (holotype) from Mountain Santubong, Sarawak: head (top) in dorsal view and meso- and metasoma (bottom) in side view.

propodeum flat. Area between the basal and declivous faces of the propodeum weakly concave, with an irregular, transversal margin, the margin forming a large, lamelliform triangular tooth largely placed on the declivous face laterally. Propodeal lobes bearing a round, slightly lamellaceous border. Propodeal spiracle round and above mid height in lateral view.

Petiole subrectangular and thick. Anterior border of the petiole straight and anterolaterally carinate. Ventral process of the petiole large and triangular. Anterior face of the postpetiole concave and laterally angulate. Postpetiolar sternite anteromedially with a marked subtriangular projection, gently convex posteriorly in side view. Constriction between postpetiole and gaster impressed. Gastral tergite I about 1/4 longer than the postpetiole and convex on the curvature. Gastral tergite I with a thick, irregular, transversal folding before the posterior margin, the folding shorter than the posterior margin. Remaining gastral tergites and sternites curved ventrally.

Legs short. All tibiae with a pectinate spur. Spurs of fore legs without basal spine. Fore basitarsi longer than the mid ones. Hind basitarsi about 1/4 shorter than hind tibiae. Second tarsomere of hind legs slightly shorter than pretarsus. Pretarsal claws simple. Arolia absent.

Sculpture. Head, mesosoma, petiole and postpetiole with variably distributed, irregular, superficial, foveae-like impressions, granulopunctate and irregularly rugulose. The rugosities longer on the postpetiole. Gaster punctate and with almost longitudinal, thick rugosities. Legs punctate.

Pilosity as in *angulinode*.

Colour. Dark ferruginous-brown with slightly lighter antennae and legs.

Measurements in mm and Indices: TL 3.41; HL 0.78; HW 0.77; EL 0.04; SL 0.59; WL 0.99; PeL 0.25; PeW 0.37; HFel 0.62; HTiL 0.53; HBaL 0.38; LS4 0.30; LT4 0.65; CI 98.7; SI 75.6; IGR 0.46.

MATERIAL EXAMINED: MALAYSIA: SARAWAK: Mountain Santubong near Kuching, 5.VI.1968, rainforest, c. 1800 ft, leaf mould berlesate, 5.VI.1968, 1 worker (holotype), G. Rothschild [ANIC].

DISCUSSION. *P. striativenter*, within the *silaceum* clade, is a very distinctive species by possessing the gaster entirely covered by thin, longitudinal striae. It shares with its sister species, *angulinode*, the postpetiole anteriorly

concave and laterally angulate and the first gastral tergite with a thick, transversal border before the posterior margin.

DISTRIBUTION: Malaysia (Sarawak).

***Proceratium banjaranense*** de Andrade n. sp.

Fig. 148

TYPE MATERIAL: holotype worker from Malaysia labelled: "SABAH, 16 mi from Keningau, 1380 m, 14.III.1983, B. Hauser", in MHNG; 8 paratype workers same data as the holotype, in BMNH and MHNG.

DERIVATIO NOMINIS: *banjaranense* is a barbarism created to recall the Banjaran Crocker area where the species was collected.

DIAGNOSIS. A *Proceratium* species belonging to the *silaceum* clade and resembling *dusun*, but differing from it, in the worker, by the hairs longer, by the petiolar node thicker and by the first gastral tergite strongly convex.

DESCRIPTION. *Worker* (Fig. 148). Head slightly longer than broad and with the sides gently diverging posteriorly. Vertex in full face view gently convex. Clypeus reduced and as long as the antennal sockets. Anterior border of the clypeus truncate. Frontal carinae far from each other, slightly covering the antennal insertions. Lateral expansions of the frontal carinae broad, little raised, diverging on the two anterior fourths, converging on the third fourth, parallel and carinate only on the last fourth. Frontal area gently concave on the three anterior fourths and with a central, thick, longitudinal carina starting from the last fourth and prolonging posteriorly. Head anterolaterally with a short, longitudinal carina. Genal carinae marked, each carina corresponding to the external border of a deep sulcus. Eyes visible as a dark dot below the integument, small and on the middle of the head sides. First funicular joint about as long as broad. Funicular joints 2-10 broader than long. Last funicular joint as long as the sum of joints 6-10. Scapes short of the vertexal margin and gently broadened apically. Masticatory margin of the mandibles with 7-10 denticles before the pointed apical tooth. Palp formula 2,2.

Mesosoma in side view gently convex and about as long as the maximum head length (mandibles included). Pronotal and propodeal sutures absent. Basal face of the propodeum declivous posteriorly. Declivous face of the propodeum gently sloping posteriorly. Sides between basal and declivous faces of propodeum weakly angulate. Sides of the declivous face superficially carinate. Propodeal spiracle round and above mid height in lateral view.

Petiole subrectangular and thick. Anterior border of the petiole straight and weakly carinate anterolaterally. Ventral process of the petiole large, stout and triangular. Postpetiole in dorsal view with the sides diverging on the anterior half and gently convex on the posterior half. Postpetiolar sternite anteromedially with a marked subtriangular projection, gently convex posteriorly in side view. Constriction between postpetiole and gaster impressed. Gastral tergite I about 1/3 longer than the postpetiole and strongly convex on the curvature. Remaining gastral tergites and sternites curved ventrally.

Legs moderately short. All tibiae with a pectinate spur. Spurs of fore legs without basal spine. Fore basitarsi longer than the mid ones. Hind basitarsi about 1/3 shorter than hind tibiae. Second tarsomere of hind legs shorter than pretarsus. Pretarsal claws simple. Arolia absent.

Sculpture. Head, mesosoma, petiole and postpetiole punctate and sparsely granulate, the granulation higher on the head and on the mesosoma. Head dorsum with additional short, irregular rugosities, longer and denser on the sides. Gaster entirely smooth and with very sparse puncture on the sides. Legs punctate.

Body covered by hairs of three types: (1) short, dense, suberect or subdecumbent on the whole body, sparse on the funicular joints; (2) longer than type (1), erect or suberect on the whole body, slightly shorter on the scapes, absent on the funiculi; (3) shorter than hair type (1), dense and decumbent on the funicular joints only. In addition the funicular joints bear whitish, thick, appressed, sparse hairs.

Colour. Dark ferruginous with lighter antennae and legs.

Measurements in mm and Indices: TL 3.00-3.38; HL 0.69-0.74; HW 0.65-0.70; EL 0.03-0.04; SL 0.45-0.49; WL 0.86-0.96; PeL 0.23-0.27; PeW 0.34-0.38; HFel 0.51-0.54; HTiL 0.42-0.47; HBaL 0.29-0.32; LS4 0.28-0.33; LT4 0.63-0.74; CI 94.2-94.6; SI 65.2-66.2; IGR 0.44.

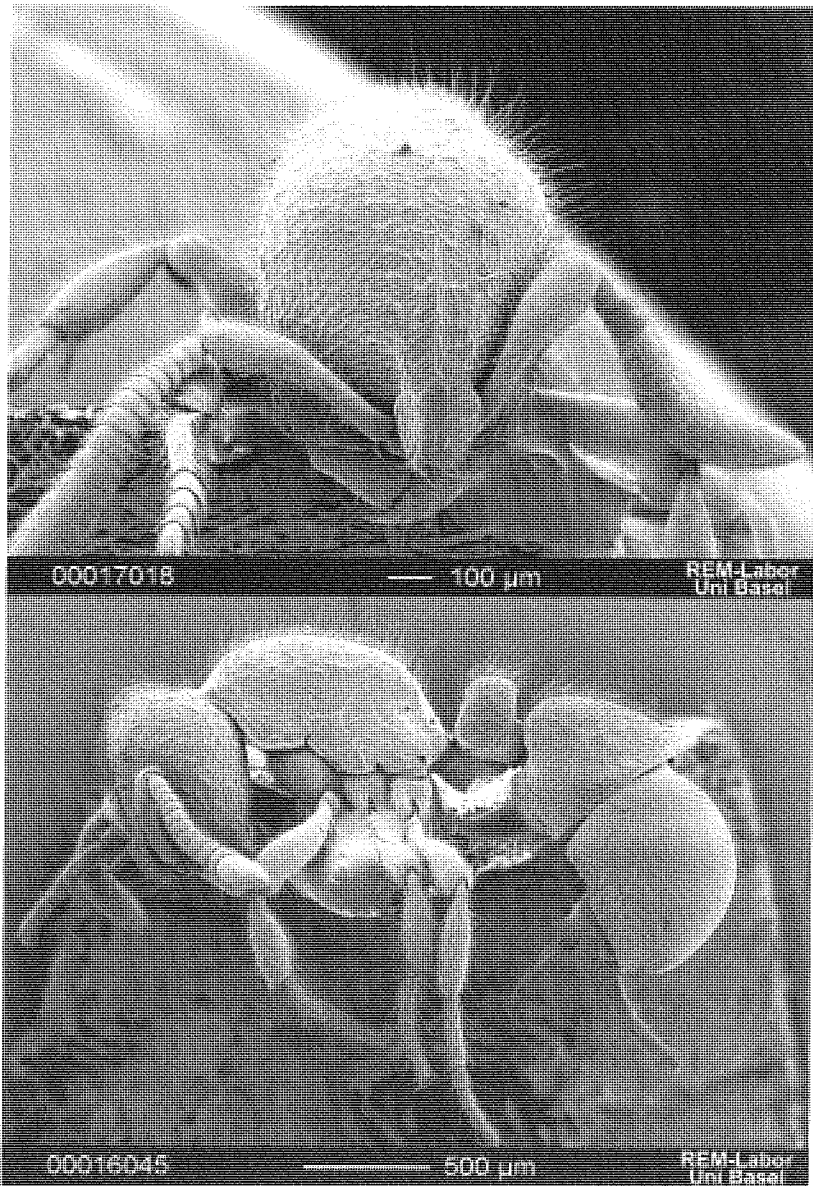


Fig. 148 – *Proceratium banjaranense* de Andrade. Worker (paratype) from 16 mi from Keningau, Sabah: head (top) in dorsal view and meso- and metasoma (bottom) in side view.



MATERIAL EXAMINED: MALAYSIA: SABAH: 16 mi from Keningau, 1280 m, 14.III.1983, 1 worker (holotype) [MHNG], 8 workers (paratypes), B. Hauser [BMNH, MHNG]; Crocker Range National Park, 60 km road K. K.-Tambunan, 1270 m, 9 workers, D. Burckhardt & I. Löbl [BMNH, MHNG].

DISCUSSION. *P. banjaranense* resembles *dusun* but the characters listed in the diagnosis distinguish easily the two species.

The workers from Crocker Range National Park differ from the type series by the petiole slightly narrower, by the colour dark brown and by the hairs slightly shorter. We prefer to consider the specimens from Crocker range as variable *banjaranense* until the collection of more material may prove that the differences above mentioned are worth of specific distinction.

DISTRIBUTION: Malaysia (Sabah).

***Proceratium dusun* de Andrade n. sp.**

Fig. 149

TYPE MATERIAL: holotype worker from Malaysia labelled: "SABAH: 850 m, Poring Hot springs, Langanan Riv., 14.V.87, Löbl + Burckhardt", in BMNH.

DERIVATIO NOMINIS: Dusun is the name of one of the local peoples of Sabah. It is used as a noun in apposition.

DIAGNOSIS. A *Proceratium* species belonging to the *silaceum* clade and resembling *banjaranense*, but differing from it, in the worker, by the shorter hairs, by the narrower petiolar node and by the first gastral tergite less convex.

DESCRIPTION. *Worker* (Fig. 149). Head slightly longer than broad and with the sides gently diverging posteriorly. Vertex in full face view gently convex. Clypeus reduced and as long as the antennal sockets. Anterior border of the clypeus truncate. Frontal carinae far from each other and slightly covering the antennal insertions. Lateral expansions of the frontal carinae

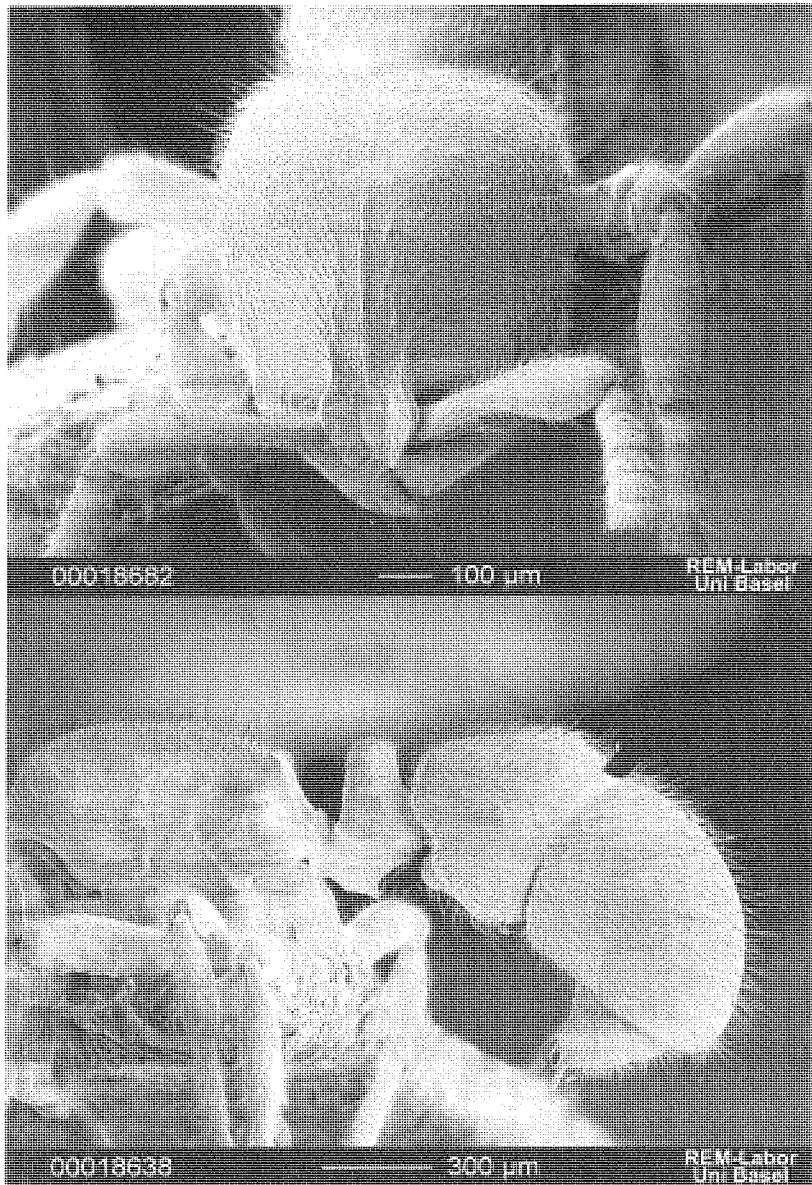


Fig. 149 – *Proceratium dusun* de Andrade. Worker (holotype) from Poring Hot springs, Langanan River, Sabah: head (top) in dorsal view and meso- and metasoma (bottom) in side view.

broad, little raised, diverging on the two anterior fourths, converging on the third fourth, parallel and carinate only on the last fourth. Frontal area gently concave on the three anterior fourths and with a central, thick longitudinal carina starting from the last fourth and prolonging posteriorly. Head anterolaterally with a short, longitudinal carina. Genal carinae marked, each carina corresponding to the external border of a sulcus. Eyes visible as a dark dot below the integument, small and on the middle of the head sides. First funicular joint about as long as broad. Funicular joints 2-10 broader than long. Last funicular joint as long as the sum of joints 6-10. Scapes short of the vertexal margin and gently broadened apically. Masticatory margin of the mandibles with 8-10 denticles before the pointed apical tooth. Palp formula 2,2.

Mesosoma in side view weakly convex and shorter than maximum head length (mandibles included). Pronotal and propodeal sutures absent. Basal face of the propodeum declivous posteriorly. Declivous face of the propodeum gently sloping posteriorly. Area between the basal and declivous faces of the propodeum gently concave medially, dorsally feebly carinate and laterally strongly angulate or denticulate. Sides of the declivous face of the propodeum marginate. Propodeal spiracle round and above mid height in lateral view.

Petiole subrectangular and narrower than in *banjaranense*. Anterior border of the petiole straight and anterolaterally strongly carinate. Ventral process of the petiole large, stout and triangular. Postpetiole in dorsal view with the sides diverging posteriorly. Postpetiolar sternite anteromedially with a marked subtriangular projection, gently convex posteriorly in side view. Constriction between postpetiole and gaster impressed. Gastral tergite I about 1/3 longer than the postpetiole and less convex on the curvature than in *banjaranense*. Remaining gastral tergites and sternites curved ventrally.

Legs slightly short. All tibiae with a pectinate spur. Spurs of fore legs without basal spine. Fore basitarsi longer than the mid ones. Hind basitarsi about 1/3 shorter than hind tibiae. Second tarsomere of hind legs shorter than pretarsus. Pretarsal claws simple. Arolia absent.

Sculpture. Head dorsum rugosopunctate and very sparsely granulate; head sides reticulate rugulose. Mesosoma, petiole and postpetiole granu-

lopunctate with few irregular rugulae on the mesosoma. Gaster smooth on the center of the posterior half; the remaining parts punctate and slightly granulate. Legs punctate.

Body covered by hairs of three types: (1) short, dense, suberect or subdecumbent on the whole body, sparse on the funicular joints; (2) longer than type (1), erect or suberect on the whole body, sparser and shorter than in *banjaranense*, absent on the antennae; (3) shorter than hair type (1), dense and decumbent on the funicular joints only. In addition the funicular joints bear whitish, thick, appressed, sparse hairs, and the scapes with sparse hairs similar to type (2) but slightly shorter.

Colour. Light ferruginous with concolour legs.

Measurements in mm and Indices: TL 2.92-3.02; HL 0.68-0.69; HW 0.64-0.66; EL 0.03-0.04; SL 0.44-0.45; WL 0.83-0.84; PeL 0.20-0.22; PeW 0.30-0.32; HFeL 0.49-0.51; HTiL 0.41-0.42; HBaL 0.27-0.29; LS4 0.30-0.32; LT4 0.61-0.64; CI 94.1-95.6; SI 63.7-65.2; IGR 0.49-0.50.

MATERIAL EXAMINED: MALAYSIA: SABAH: Poring Hot Springs, Langanan River, 850 m, 14.V.1987, 1 worker (holotype), I. Löbl & D. Burckhardt [BMNH]; mi 43 Labuk Rd. ex Sandakan (Lungmanis), 13.VI.1968, nest ex rotten log rainforest, Vial 6.10, 4 workers, R. W. Taylor [ANIC].

DISCUSSION. In addition to the characters listed in the diagnosis to distinguish *dusun* from *banjaranense*, we can add that *dusun* is more sculptured and has a less shining gaster.

DISTRIBUTION: Malaysia (Sabah).

### ***Proceratium snellingi*** Baroni Urbani & de Andrade n. sp.

Fig. 150

TYPE MATERIAL: holotype worker from Papua New Guinea labelled: "PNG. Gulf Prov.: Ivimka camp. Lakekamu Basin, 7.7°S 146.8°E 120 m el., 12 Nov. 1996, R. R. Snelling # 96-316, Lowland wet forest: ex sifted leaf litter"; 1 paratype worker same data as the holotype, both in LACM.

DERIVATIO NOMINIS: this species is named after Roy R. Snelling who collected it and loaned us these and many other important specimens in study.

DIAGNOSIS. A *Proceratium* species belonging to the *silaceum* clade and similar to *papuanum*, and differing it, in the worker, by its small size coupled with a broad head ( $TL \leq 2.29$  mm and  $CI \geq 100$ ).

DESCRIPTION. *Worker* (Fig. 150). Head as broad as long and with the sides gently diverging posteriorly. Vertex in full face view gently convex. Clypeus reduced and about as long as the antennal sockets. Anterior border of the clypeus truncate. Frontal carinae far from each other, not covering the antennal insertions. Lateral expansions of the frontal carinae broad, little raised, diverging on the two anterior fourths, converging on the third fourth, subparallel and carinate on the last fourth only. Frontal area gently concave on the three anterior fourths and with a central, thick longitudinal carina starting from the last fourth and prolonging posteriorly. Head anterolaterally with a short, thin, longitudinal carina. Genal carinae marked, each carina corresponding to the external border of a sulcus. Eyes visible as a dark dot below the integument, small and on the middle of the head sides. First funicular joint slightly broader than long. Funicular joints 2-10 broader than long. Last funicular joint as long as the sum of joints 6-10. Scapes short of the vertexal margin and gently thickening apically. Masticatory margin of the mandibles with 7-8 denticles before the pointed apical tooth. Palp formula 2,2.

Mesosoma convex and shorter than maximum head length (mandibles included) in profile. Pronotal and propodeal sutures absent. Basal face of the propodeum declivous posteriorly. Declivous face of the propodeum gently sloping posteriorly. Sides between the basal and declivous faces of the propodeum weakly angulate. Sides of the declivous face superficially marginate. Propodeal spiracle round and above mid height in lateral view.

Petiole subrectangular and slightly flattened. Anterior border of the petiole straight and anterolaterally weakly carinate. Ventral process of the petiole large, stout, subtriangular and pointed backwards. Postpetiole in dorsal view with gently convex sides. Postpetiolar sternite anteromedially with a marked subtriangular projection, gently convex posteriorly in side view. Constriction between postpetiole and gaster impressed. Gastral tergite I about 1/3 longer than the postpetiole and convex on the curvature. Remaining gastral tergites and sternites curved ventrally.

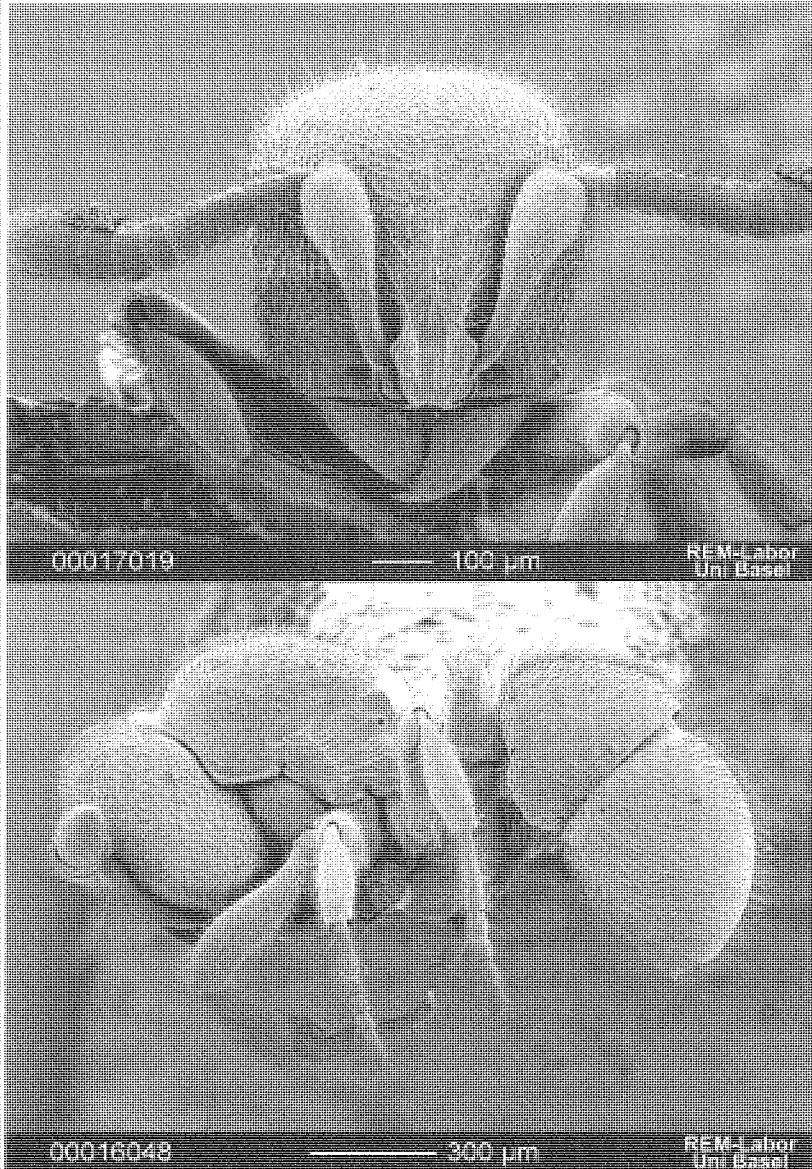


Fig. 150 – *Proceratium snellingi* Baroni Urbani & de Andrade. Worker (paratype) from Gulf Province, Ivimka, Papua New Guinea: head (top) in dorsal view and meso- and metasoma (bottom) in side view.

Legs short. All tibiae incrassate and with a pectinate spur. Spurs of fore legs without basal spine. Fore basitarsi longer than the mid ones. Hind basitarsi about 1/3 shorter than hind tibiae. Second tarsomere of hind legs shorter than pretarsus. Pretarsal claws simple. Arolia absent.

Sculpture. Head and mesosoma minutely reticulorugose. Petiole and postpetiole sparsely punctate. Gaster smooth and with minute piligerous punctures, denser on the sides. Legs minutely punctate.

Body covered by hairs of three types: (1) short, dense, suberect or subdecumbent on the whole body, sparse on the funicular joints; (2) longer than type (1), erect on the whole body and absent on the antennae; (3) shorter than hair type (1), dense and decumbent on the funicular joints only. In addition the funicular joints bear whitish, thick, appressed, sparse hairs, and the scapes with sparse hairs similar to type (2) but slightly shorter.

Colour. Dark ferruginous-brown with the posterior half of the head and the dorsum of the mesosoma darker. Antennae and legs lighter.

Measurements in mm and Indices: TL 2.25-2.29; HL 0.54; HW 0.54-0.55; EL 0.03-0.04; SL 0.35; WL 0.60-0.64; PeL 0.14-0.15; PeW 0.25; HFeL 0.3-0.37; HTiL 0.30-0.31; HBaL 0.20; LS4 0.22-0.23; LT4 0.48; CI 100.0-101.8; SI 64.8; IGR 0.46-0.48.

*Gyne*. Differing from the worker in the following details: eyes large, about 1/3 of the head length, composed by many facets and with ocular pilosity. Ocelli well developed.

Mesosoma longer than the head (mandibles included), robust and convex in side view. Parapsidal furrows marked. Scutellum with the sides converging posteriorly and with the posterior border round. Dorsum of the scutellum with a thick longitudinal ruga prolonging up to the posterior half of the mesonotum. Metanotum with a small lamellaceous tooth. Basal face of the propodeum medially concave. Area between the basal and declivous faces of the propodeum superficially carinate and angulate on each side.

Sculpture: anterior half of the mesonotum punctate only. Scutellum reticulorugose. Punctuation on the petiole, postpetiole and gaster more marked.

Measurements in mm and Indices: TL 2.96-3.05; HL 0.63; HW 0.63; EL 0.19-0.20; SL 0.40-0.41; WL 0.90-0.92; PeL 0.19-0.20; PeW 0.33-0.34;

HFeL 0.48-0.50; HTiL 0.38-0.40; HBaL 0.27-0.29; LS4 0.29-0.33; LT4 0.63-0.69; CI 100.0; SI 63.5-65.1; IGR 0.46-0.48.

MATERIAL EXAMINED: PAPUA NEW GUINEA: Gulf Province: Ivimka, camp. Lakekamu Basin, 7.7°S 146.8°E 120 m elevation, 12.XI.1996, lowland wet forest: ex sifted leaf litter, 2 workers (holotype and paratype), R. R. Snelling [LACM]; Baiyer R., Sanctuary, 1-5.IX.1969, 1 worker, 1 gyne, J. Balogh [MCZC]; W Highlands, Baiyer R., 6.VII.1974, 4000 ft, 1 gyne, Peck [MCZC].

DISCUSSION. *P. snellingi* is a relatively small species. It shares with *angulinode*, *striativenter*, *banjaranense*, *dusun* and *papuanum* the hind basitarsi with at least one hair longer than 1/2 of the hind basitarsi. Among these five species, *snellingi* resembles particularly *papuanum*, but *snellingi* differs from *papuanum* by the characters already mentioned in the diagnosis and by the more sculptured body and by the narrower frontal carinae.

DISTRIBUTION: Papua New Guinea.

### ***Proceratium sulawense* de Andrade n. sp.**

Figs. 151, 152

*Proceratium* nr. *carinifrons* or *lombokense*, Brown, 1974: 82.

TYPE MATERIAL: holotype worker from Sulawesi labelled: "INDONESIA: SULAWESI UTARA, Danau Mooat, 1200 m, nr Kotamobagu, 13.IX.1985", in BMNH.

DERIVATIO NOMINIS: "*sulawense*" is a neologism indicating the provenance of the species from Sulawesi.

DIAGNOSIS. A *Proceratium* species belonging to the *silaceum* clade and resembling *dusun*, but differing from it, in the worker, by the broader frontal carinae and by the CI > 101.5 instead of < 97.



DESCRIPTION. *Worker* (Figs. 151 & 152). Head as broad as long or slightly broader than long and with the sides gently convex. Vertex in full face view weakly convex. Clypeus reduced and as long as the antennal sockets. Anterior border of the clypeus truncate. Frontal carinae far from each other, slightly covering the antennal insertions. Lateral expansions of the frontal carinae broad, little raised, diverging on the two anterior fourths, converging on the third fourth, subparallel and carinate only on the last fourth. Frontal area gently concave on the three anterior fourths and with a central, thick longitudinal carina starting from the last fourth and prolonging posteriorly. Head anterolaterally with a short, thin, longitudinal carina. Genal carinae marked, each carina corresponding to the external border of a deep sulcus. Eyes visible as by a dark dot below the integument, small and on the middle of the head sides. First funicular joint slightly longer than broad. Funicular joints 2-10 broader than long. Last funicular joint as long as the sum of joints 6-10. Scapes short of the vertexal margin and gently thickening apically. Masticatory margin of the mandibles with 8 denticles before the pointed apical tooth. Palp formula 2,2.

Mesosoma in side view gently convex and about as long as the maximum head length (mandibles included). Pronotal and propodeal sutures absent. Basal face of the propodeum declivous posteriorly. Area between the basal and declivous faces of the propodeum concave, dorsally carinate and laterally denticulate. Declivous face of the propodeum gently sloping posteriorly. Sides of the declivous face carinate. Propodeal spiracle round and above mid height in lateral view.

Petiole subrectangular and slightly compressed. Anterior border of the petiole straight and anterolaterally carinate. Ventral process of the petiole large, stout and triangular. Postpetiole in dorsal view with sides diverging on the anterior half and gently convex on the posterior half. Postpetiolar sternite anteromedially with a marked subtriangular projection, gently convex posteriorly in side view. Constriction between postpetiole and gaster impressed. Gastral tergite I about 1/3 longer than the postpetiole and convex on the curvature. Remaining gastral tergites and sternites curved ventrally.

Legs relatively short. All tibiae with a pectinate spur. Spurs of fore legs without basal spine. Fore basitarsi longer than the mid ones. Hind basitarsi about 1/4 shorter than hind tibiae. Second tarsomere of hind legs shorter than pretarsus. Pretarsal claws simple. Arolia absent.

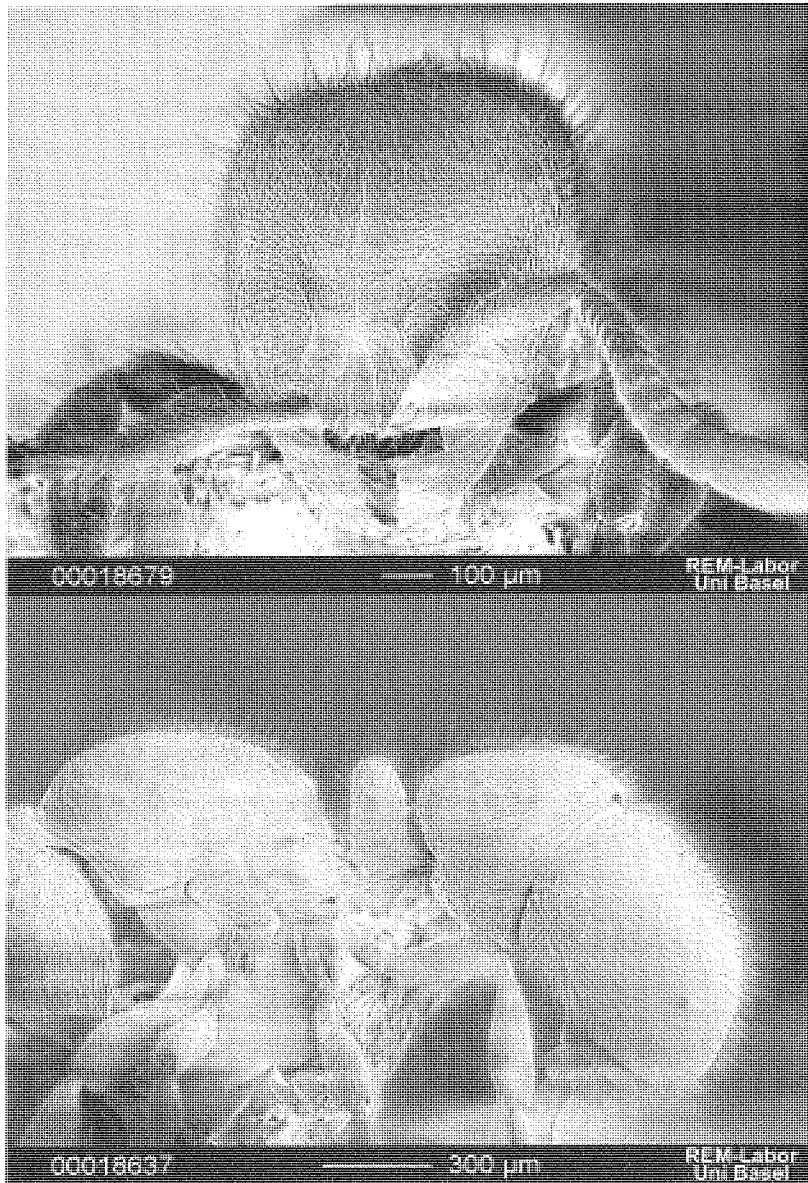


Fig. 151 – *Proceratium sulawense* de Andrade. Worker (holotype) from Danau Mooat near Kotamobagu, Sulawesi: head (top) in dorsal view and meso- and metasoma (bottom) in side view.

Sculpture. Head dorsum rugosopunctate, the rugosities thicker and slightly longitudinal on the sides. Mesosoma, petiole, postpetiole, anterior and sides of the first gastral tergite minutely granulopunctate. Remaining gastral tergite smooth and with minute piligerous punctures. Legs punctate.

Body covered by hairs of three types: (1) short, dense, suberect or subdecumbent on the whole body, sparse on the funicular joints; (2) longer than type (1), erect on the whole body, slightly shorter on the scapes, absent on the funiculi; (3) shorter than hair type (1), dense and decumbent on the funicular joints only. In addition the funicular joints bear whitish, thick, appressed, sparse hairs.

Colour. Dark ferrugineous with lighter antennae and legs.

Measurements in mm and Indices: TL 2.90; HL 0.65; HW 0.66; EL 0.04; SL 0.42; WL 0.80; PeL 0.21; PeW 0.31; HFeL 0.47; HTiL 0.38; HBaL 0.29; LS4 0.31; LT4 0.62; CI 101.5; SI 64.6; IGR 0.50.

*Gyne* (tentative attribution). Differing from the worker in the following details: eyes large, about 1/4 of the head length, composed by many facets and with ocular pilosity. Ocelli well developed.

Mesosoma robust and convex in side view. Parapsidal furrows marked. Scutellum with the sides converging posteriorly and with the posterior border round. Dorsum of the scutellum with a thick, longitudinal ruga prolonging up to the posterior half of the mesonotum. Metanotum with a small lamellaceous tooth. Basal face of the propodeum medially concave. Area between basal and declivous faces of the propodeum carinate and with a salient tooth on each side.

Measurements in mm and Indices: TL 4.32-4.34; HL 0.89-0.91; HW 0.94-0.95; EL 0.23-0.26; SL 0.59-0.60; WL 1.32-1.36; PeL 0.27-0.29; PeW 0.43-0.45; HFeL 0.75-0.76; HTiL 0.58-0.60; HBaL 0.50; LS4 0.43-0.47; LT4 0.88-0.92; CI 104.4-105.6; SI 65.9-66.3; IGR 0.49-0.51.

MATERIAL EXAMINED: INDONESIA: SULAWESI UTARA: Danau Mooat, near Kotamobagu, 1200 m, 13.IX.1985, 1 worker (holotype) [BMNH]; Dumonga-Bone National Park, 7.VI.1985, 1 gyne [BMNH]; SW slope Mt. Klabat, 400-600 m, 13-19.VI.1972, rot. wood, 1 gyne, W. L. Brown [MCZC]. ?MALAYSIA: SARAWAK: Gunung Penrissen, 1000 m, 23.V.1994, edge primary montane forest, 1 worker, I. Löbl & D. Burckhardt [MHNG].

DISCUSSION. The MHNG unique specimen from Sarawak resembles *sulawense* in general appearance but is larger (TL 3.46 mm, CI 97.4), the frontal carinae are narrower and the propodeal sides are only weakly angulate. It may well represent another new species, but we prefer not to describe it on a single specimen. To avoid possible confusion its measurements are not reported within those given for *sulawense*. They are as follows: TL 3.46; HL 0.76; HW 0.74; EL 0.04; SL 0.51; WL 0.98; PeL 0.26; PeW 0.38; HFeL 0.58; HTiL 0.48; HBaL 0.37; LS4 0.36; LT4 0.74; CI 97.4; SI 67.1; IGR 0.49.

DISTRIBUTION: Indonesia (Sulawesi), ? Malaysia (Sarawak).

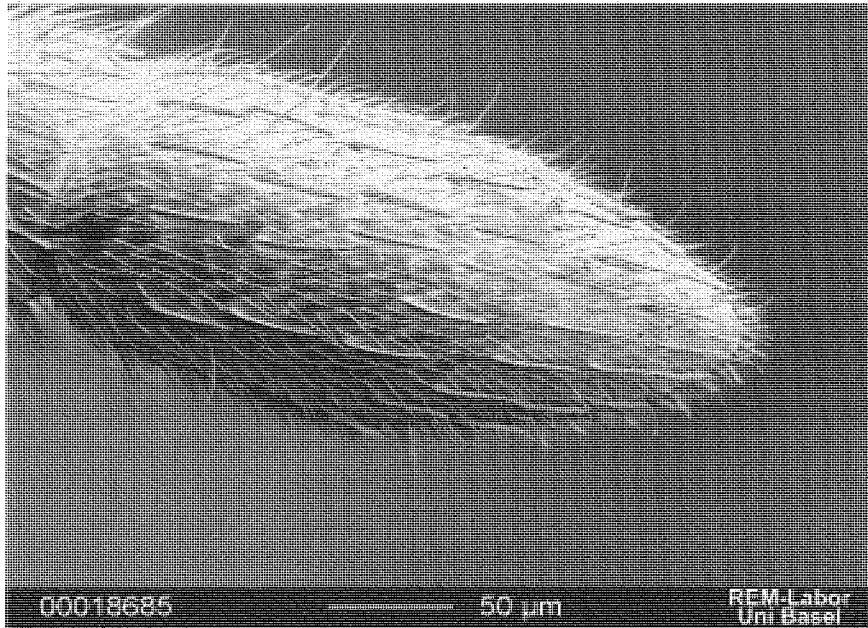


Fig. 152 – *Proceratium sulawense* de Andrade. Worker from Danau Mooat near Kotamobagu, Sulawesi: last funicular joint.

**Proceratium croceum** (Roger)

Figs. 1, 153, 154, 155, 156, 157, 158

*Ponera crocea* Roger, 1860: 288. Gyne. Original description. Type locality: Carolina, USA. Type material: holotype gyne without postpetiole and gaster labelled: "Carolina, TYPE, *crocea* Roger, *Proceratium croceum* Rog, Zool. Mus. Berlin"; in ZMBC, examined.

*Sysphingta crocea* (Roger), Mayr, 1866: 501. First combination in *Sysphingta*.

*Proceratium croceum* (Roger), Mayr, 1886: 437. First combination in *Proceratium*.

*Proceratium croceum* (Roger), Emery, 1895: 265, pl. 8, figs. 5 (worker) & 6 (gyne).

Worker.

*Proceratium croceum* (Roger), Smith, 1930: 390. Male.

*Proceratium croceum* (Roger), Wheeler & Wheeler, 1952: 135, pl. v, figs. 20-27. Larva.

**DIAGNOSIS.** A *Proceratium* species belonging to the *silaceum* clade and resembling *silaceum* but differing from it in the worker, gyne and male by the thicker petiole, by stronger sculpture and by the larger size: worker TL > 3.7 mm, gyne TL > 5.1 mm, male TL > 4.0 mm instead of worker TL < 3.5 mm, gyne TL < 4.1 mm, male TL < 3.3 mm.

**DESCRIPTION.** *Worker* (Figs. 1, 153, 154 & 155). Head slightly longer than broad or almost as long as broad and with subparallel sides. Vertex in full face view weakly convex. Clypeus reduced and as long as the antennal sockets. Anterior border of the clypeus truncate. Frontal carinae far from each other, slightly covering the antennal insertions. Lateral expansions of the frontal carinae broad, weakly raised, diverging on the two anterior fourths, converging on the third fourth, subparallel and carinate only on the last fourth. Frontal area gently concave on the anterior three fourths and with a median, longitudinal carina and prolonging posteriorly. Head anter-olaterally with a longitudinal carina. Genal carinae marked, each carina corresponding to the external border of a deep sulcus. Eyes represented by a dark dot below the integument, small and placed on the middle of the head sides. First funicular joint slightly longer than broad. Funicular joints 2-10 broader than long. Last funicular joint as long as the sum of joints 8-10, or slightly shorter than the sum of joints 7-10, or as long as their sum. Scapes short of the vertexal margin and gently broadened apically. Masticatory margin of the mandibles with 11-13 denticles before the pointed apical tooth. Palp formula 2,2.

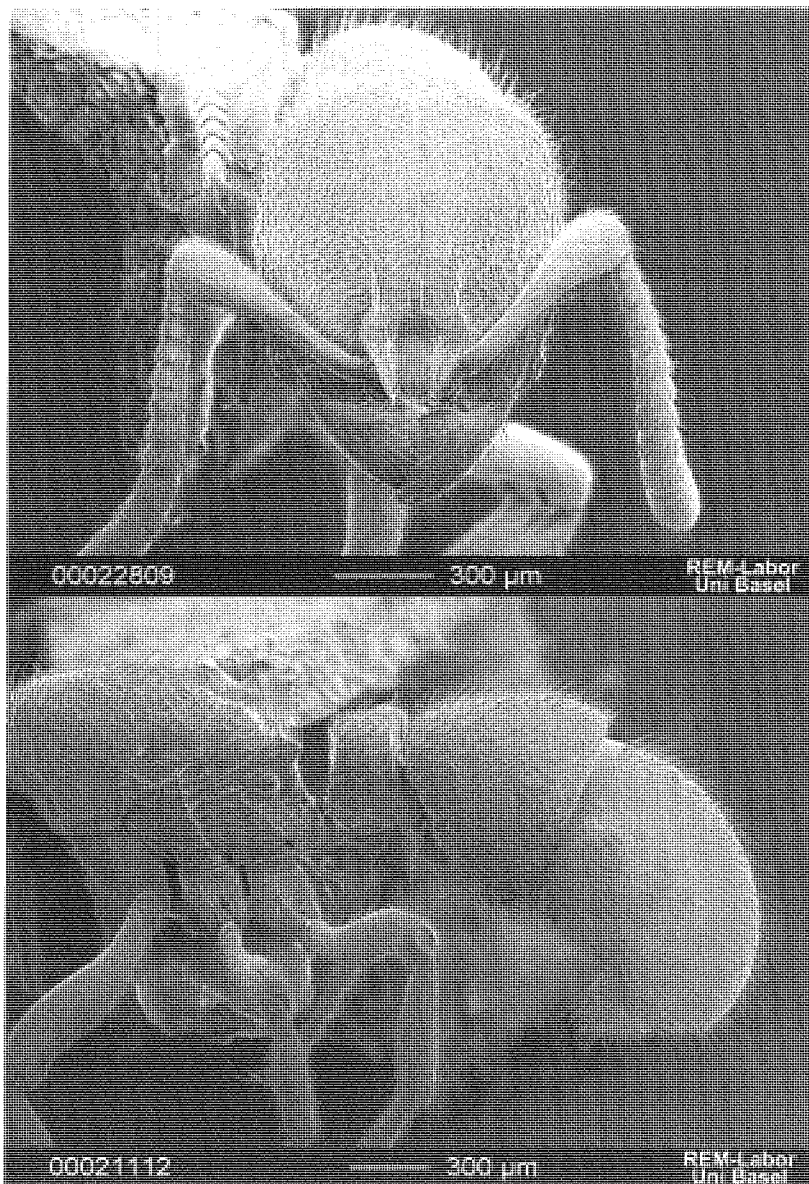


Fig. 153 – *Proceratium croceum* (Roger). Worker from Aberdeen, Mississippi, USA: head (top) in dorsal view and meso- and metasoma (bottom) in side view.

Mesosoma in side view convex on the two anterior thirds, sloping on the posterior third, and about as long as the maximum head length (mandibles included). Pronotal and propodeal sutures superficially impressed. Basal face of the propodeum declivous posteriorly. Area between the basal and declivous faces of the propodeum gently concave, dorsally variably carinate and laterally with a broad tooth. Declivous face of the propodeum gently sloping posteriorly. Sides of the declivous face of the propodeum carinate. Propodeal spiracle round and above mid height in lateral view.

Petiole rectangular and broad. Anterior border of the petiole straight and anterolaterally carinate, with the posterodorsal border of the node superficially carinate and medially angulate in dorsal view. Ventral process of the petiole large, lamelliform, oblique anteriorly and pointed posteriorly. Postpetiole in dorsal view with the sides diverging on the anterior half and gently convex on the posterior half. Postpetiolar sternite anteromedially with a marked subtriangular projection, gently convex posteriorly in side view. Constriction between postpetiole and gaster impressed. Gastral tergite I about 1/2 longer than the postpetiole and convex on the curvature. Remaining gastral tergites and sternites curved ventrally.

Legs moderately elongate. All tibiae with a pectinate spur. Spurs of fore legs without basal spine. Fore basitarsi longer than the mid ones. Hind basitarsi about 1/4 or 1/5 shorter than hind tibiae. Second tarsomere of hind leg shorter than pretarsus. Pretarsal claws simple. Arolia absent.

Sculpture. Head and mesosoma minutely punctate, reticulorugose, the reticulation larger on the sides of the head, the rugosities thicker and slightly longitudinal on the head sides and slightly concentric on the pronotum and on the mesonotum. Petiole and postpetiole reticulate, the reticulation deep and foveae-like. First gastral tergite smooth and with minute piligerous punctures. Legs punctate.

Body covered by hairs of three types: (1) short, dense, suberect or subdecumbent, erect and sparse on the funicular joints; (2) longer than type (1), erect, absent on the antennae; (3) shorter than hair type (1), dense and decumbent on the funicular joints. In addition the funicular joints bear whitish, thick, appressed, sparse hairs, and the scapes with sparse hairs similar to type (2) but slightly shorter.

Colour. Ferruginous-brown with lighter antennae and legs.

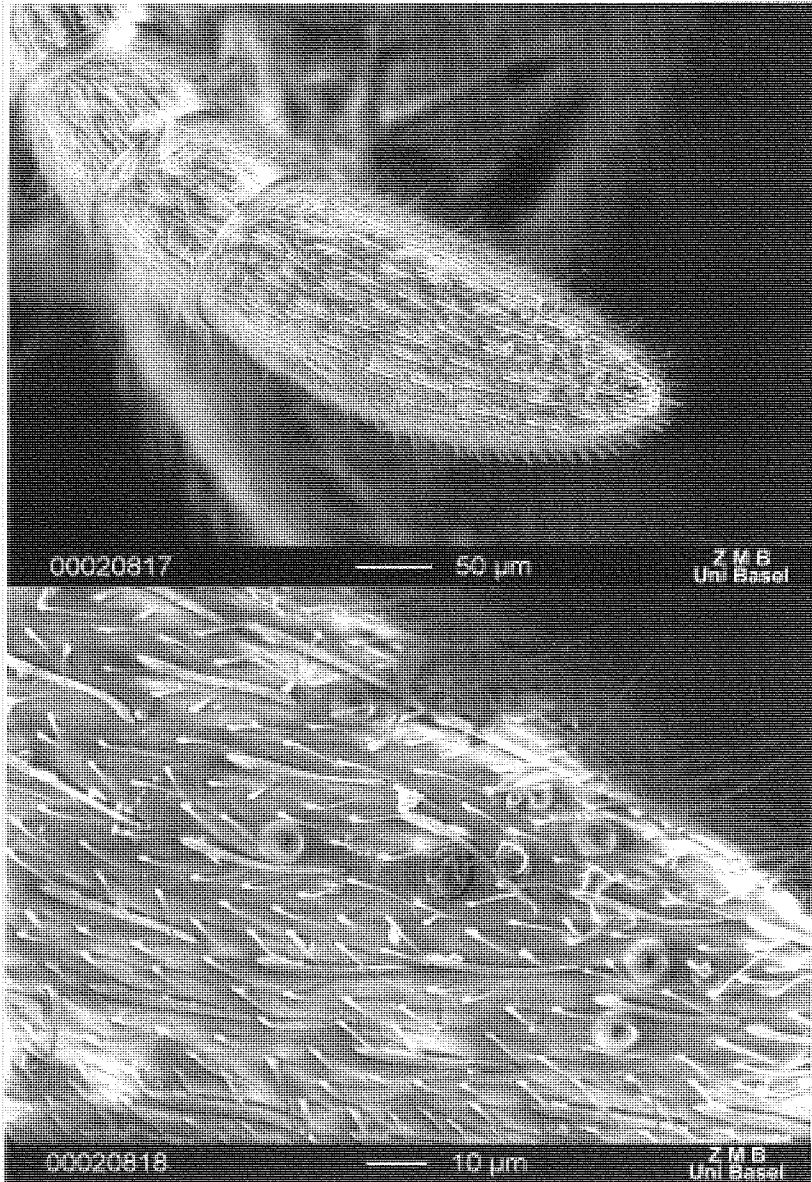


Fig. 154 – *Proceratium croceum* (Roger). Worker from Aberdeen, Mississippi, USA: last three funicular joints (top) and button-like structures on the last funicular joint (bottom).



Measurements in mm and Indices: TL 3.86-5.03; HL 0.84-1.04; HW 0.83-1.02; EL 0.04-0.06; SL 0.60-0.71; WL 1.08-1.36; PeL 0.28-0.39; PeW 0.38-0.51; HFeL 0.68-0.86; HTiL 0.55-0.69; HBaL 0.41-0.55; LS4 0.44-0.64; LT4 0.82-1.12; CI 98.0-98.8; SI 68.2-1.4; IGR 0.54-0.57.

*Gyne*. Differing from the worker in the following details: eyes large, slightly more than 1/4 of the head length, composed by many facets and with ocular pilosity. Ocelli well developed.

Mesosoma robust and gently convex in side view. Parapsidal furrows marked. Scutellum with the sides converging posteriorly and with the posterior border round. Dorsum of the mesonotum and scutellum with a longitudinal carina thicker posteriorly. Metanotum with a large lamellaceous tooth. Basal face of the propodeum flat.

Fore wings of our type 4, hind wings of our type 3 as defined in the description of the genus (Fig. 156).

Sculpture. Mesosoma variably reticulorugose, sometimes the rugulae absent.

Measurements in mm and Indices: TL 5.23-5.43; HL 1.04-1.08; HW 1.00-1.02; EL 0.28-0.30; SL 0.71-0.73; WL 1.52-1.60; PeL 0.39; PeW 0.56; HFeL 0.94-0.97; HTiL 0.71-0.75; HBaL 0.60-0.62; LS4 0.63-0.72; LT4 1.16-1.28; CI 94.4-96.1; SI 67.6-69.2; IGR 0.53-0.56.

*Male* (Fig. 157). Head slightly broader than long. Vertex in full face view strongly convex. Vertexal margin carinate. Clypeus reduced, truncate and as long as or slightly longer than the antennal sockets. Frontal carinae thin, low, parallel. Frontal area convex anteriorly and concave posteriorly. Ocelli large. Compound eyes large and occupying mostly the anterior part of the head sides. Scapes almost reaching the anterior ocellus. First funicular joint about 1/2 shorter than the second joint. Joints 2-12 much longer than broad. Last funicular joint about as long as the sum of joints 10-11. Mandibles edentate and only with a pointed apical tooth. Palp formula 5,2.

Mesosoma robust and convex in profile. Pronotum and anterior third of mesonotum almost perpendicular to the posterior two thirds of the mesonotum. Parapsidal furrows marked. Scutellum slightly higher than the mesonotum; posterior border of scutellum round. Basal face of the propodeum flat and with an incision prolonging to the anterior part of the

declivous face medially. Sides between basal and declivous faces of the propodeum angulate. Declivous face of propodeum flat. Metanotum with a median, broad, spiniform tooth. Lower part of the propodeal lobes truncate and upper part round and partially lamelliform. Propodeal spiracles small.

Petiole in side view with truncate or declivous anterior face, the node subrectangular. Anterior border of the petiole laterally carinate. Subpetiolar

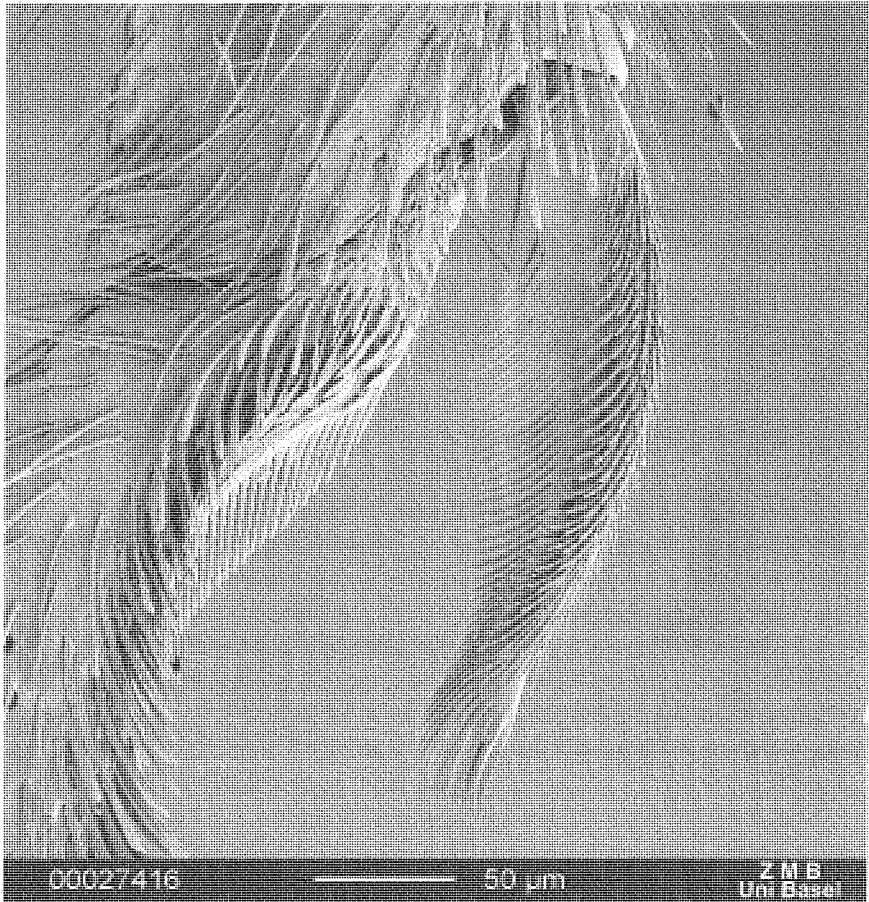


Fig. 155 – *Proceratium croceum* (Roger). Worker from 3.5 miles NE Gainesville, Alachua Co, Florida, USA: right fore tibial spur without basal spine.

process as in the worker and gyne but less developed. Postpetiole anteriorly slightly broader than the petiole; postpetiolar sides gently convex. Anterior border of the postpetiolar sternite with a superficial triangular "lip". Gastral tergite I convex in side view. Gastral sternite I large. Remaining gastral tergites and sternites slightly curved ventrally.

Legs as in the worker but more elongate. Hind basitarsi slightly shorter than hind tibiae.

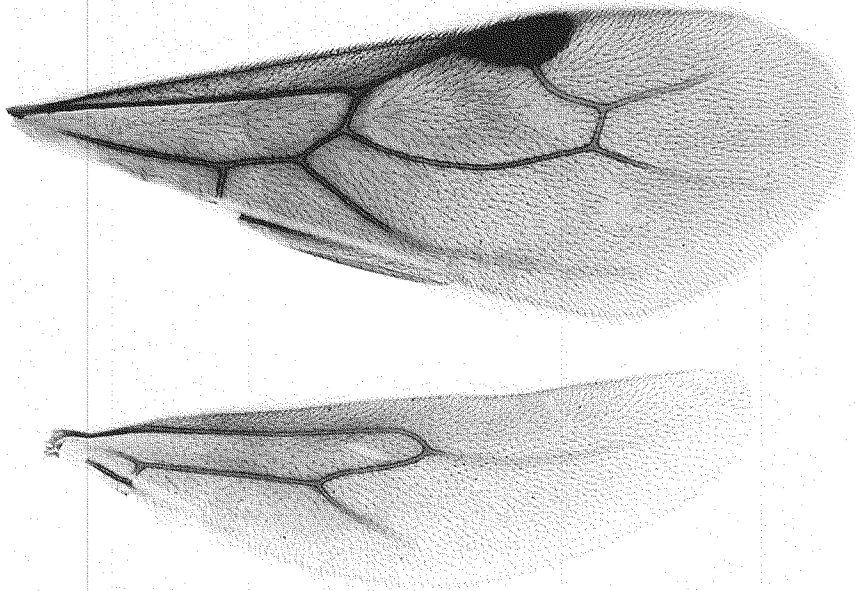


Fig. 156 — *Proceratium croceum* (Roger). Gyne from Aberdeen, Mississippi, USA: fore and hind wings.

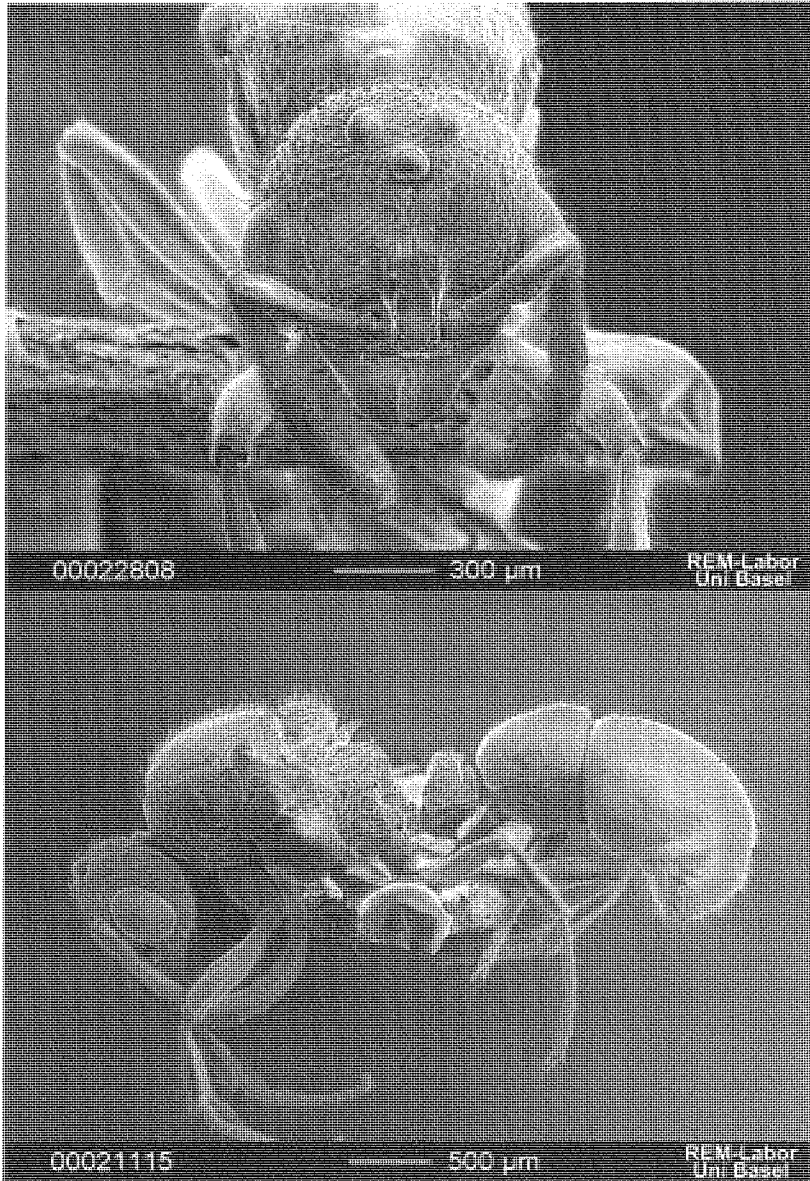


Fig. 157 – *Proceratium croceum* (Roger). Male from Aberdeen, Mississippi, USA: head (top) in dorsal view and meso- and metasoma (bottom) in side view.

Fore wings of our type 4, hind wings of our type 3 as defined in the description of the genus.

Genitalia as in Fig. 158.

Sculpture. Head, mesosoma and petiole reticulorugose, this sculpture more marked and larger on the propodeum. Postpetiole and gaster smooth and with minute piligerous punctures. Legs superficially smooth and minutely punctate.

Pilosity as in the worker but with the hairs of type (2) slightly longer on the gaster.

Colour. Head, dorsum of the mesosoma and of the petiole dark brown-black with the remaining body parts lighter.

Measurements in mm and Indices: TL 4.14-4.60; HL 0.71-0.78; HW 0.74-0.80; EL 0.35-0.39; SL 0.38-0.40; WL 1.36-1.54; PeL 0.29-0.33; PeW 0.38-0.43; HFeL 0.83-0.91; HTiL 0.59-0.69; HBaL 0.57-0.64; LS4 0.49-0.64; LT4 0.87-1.12; CI 102.6-104.2; SI 51.3-53.5; IGR 0.56-0.61.

MATERIAL EXAMINED: no locality, 1 gyne [NHMW]. UNITED STATES: ILLINOIS: Herod, 12.X.1933, 2 gynes, Frison & Ross [MZSP, USNM]. OKLAHOMA: Latimer Co., VIII.1986, 1 male, K. Stephan [FSCA]. ARKANSAS: Marion Co., 1 gyne, June, J. C. Bridwell [USNM]; Ashley Co., 15.VIII.1972, 2 gynes, R. Roe [FSCA]. TENNESSEE: Coffee Co., near Manchester, 3.VIII.1941, 2 workers, D. W. Pfitzer [USNM]; Union Co., 15.VII.1947, 2 workers, J. W. Jones [LACM]. MISSISSIPPI: no further locality, 1 gyne [USNM]; Aberdeen, 3 workers, 5 gynes, 1 male [LACM, USNM]; same locality, 1 worker, 1 gyne, 2 males, M. R. Smith [MCZC, USNM]; same locality, 24.V.1930, 10 workers, M. R. Smith [MZSP, USNM]; Starkville, 13 workers, M. R. Smith, [CASC, LACM, MZSP, NHMB, USNM]; Louisville, 3.X.1930, 1 worker, M. R. Smith [LACM]; same locality, 15.V.1931, 2 workers, M. R. Smith [USNM]; State College, 7 workers, M. R. Smith [MCZC, USNM]; Sturgis, 2 workers [USNM]; Columbus, IV.1928, 2 gynes, M. R. Smith [USNM]; Lucedale, 19.I.1931, 1 gyne, H. Dietrich [USNM]; Choctaw Co., Tombigbee Natural Forest, 19 & 20.V.1993, 3 workers, L. R. Davis Jr. [MCZC]. ALABAMA: Mobile, 1 gyne, Y. Ailer [LACM]; Spring Hill, Mobile, 12.V.1929, 12 workers, 1 gyne, W. S. Creighton [LACM, MCZC, NHMB]; same locality, 1 & 22. VI.1929, 13 workers, W. S. Creighton [LACM]; Dog River, Mobile, 15.VI.1929, 3 workers, W. S. Creighton [LACM]; Kushla, 1 gyne, 9.V.1929, A. H. Sturte-

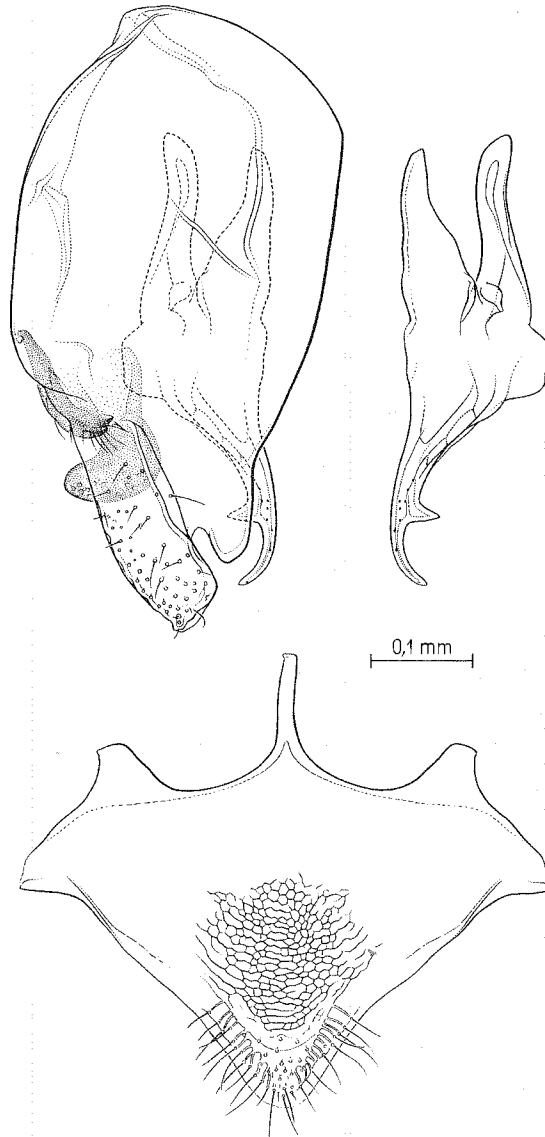


Fig. 158 – *Proceratium croceum* (Roger). Male from Aberdeen, Mississippi, USA. Genital appendages: a) lateral view of left parameres and of their relative positions; b) right aedeagus in profile; c) subgenital plate in ventral view.

vant [USNM]; Lookout Mountain, Fort Payne, 12.VII.1929, 4 workers, W. S. Creighton [USNM]; Jacksons Oak, Baldwin Co., 9.VI.1929, 5 workers, Creighton [LACM]; Point Clear, Baldwin Co., 5.VI.1929, 1 worker, Creighton [LACM]; Whistler, 23.VI.1929, 2 workers, W. S. Creighton [LACM]; Montgomery, 7.VII.1929, 6 workers, Creighton [LACM]; same locality, Tallapoosa river, 7.VII.1929, 7 workers, Creighton [LACM]; Ft. Payne, 12.VII.1929, 4 workers, Creighton [USNM]; E Alberta, Tuscaloosa, 1.IV.1949, 1 gyne, B. D. Valentine [MCZC]. LOUISIANA: Calvin, 1937, 2 workers, M. R. Smith [USNM]; Kisatchie, 27.VII.1942, 1 gyne, Wm. Buren [USNM]; Camp Beauregard, Beauregard Par., 22.IV.1945, 3 workers, W. F. Buren [LACM]; Camp Beauregard, Rapides Parish, 14.V.1945, 6 workers, W. F. Buren [LACM]. VIRGINIA: Woodford, 15.IX.1920, 5 workers, F. C. Craighead [USNM]; Virginia Beach, 1 gyne, Beusen & Müller [MCZC]. CAROLINA, 1 gyne (holotype) [ZMBC]. NORTH CAROLINA: Raleigh, 5.XI.1948, 1 gyne, R. L. Rabb [MCZC]; Duke Forest, Durham, 28.VII.1943, 2 gynes, V. E. Shelford [USNM]. SOUTH CAROLINA: Calhoun Falls, 1 gyne, E. S. G. Titus [USNM]. TEXAS: no further locality, 1 worker, Belfrage [NHMW]. GEORGIA: Ft. Gordon, Richmond Co., 15.XI.1958, 2 gynes, R. R. Snelling [LACM]. FLORIDA: Palatka, 23.X.1943, 1 gyne, W. S. Ross [CASC]; Putnam County, 23.XI.1949, 8 workers, 1 gyne, A. Van Pelt [UCFC]; Peroy, Taylor Co., 3.VII.1965, 1 worker, W. Suter [ABSC]; Leon Co., 18.X.1984, 1 male, P. Calabi [MCZC]; Tallahassee, 28.IV.1973, 1 worker, E. O. Wilson [MCZC]; Alachua Co., 5.5 miles W Gainesville, 19 & 24.IV.1992, in pine log, 2 workers, L. R. Davis Jr. [ABSC, MCZC]; same locality, 3.5 miles NE Gainesville, 11.X.1997, ex rotten pine log, 1 worker, L. R. Davis Jr. & R. Burges [MCZC]; Alachua Co., Austin Cary Forest, 28.II.1993, 1 gyne, L. R. Davis Jr. [ABSC]; Defuniak Springs, Walton Co., 24.III.1991, 1 worker, M. Deyrup [ABSC]; Jackson Co., Three Rivers St. Rec. Area, 31.VIII.1996, 2 workers, 1 gyne, L. R. Davis Jr. [ABSC]; Lévy Co., Manatee Springs State Park, North End Trails, 16.V.1992, 1 worker, L. R. Davis Jr. [ABSC]; Hamilton Co., S. R. 6.2 mi E of Jasper, Snake Pond Area, 3.VI.1994, 3 workers, Z. Prusak [ABSC].

DISCUSSION. *P. croceum* is the largest species of the *silaceum* group known from the United States. The characters listed in the diagnosis allow an easy separation from *silaceum*. In addition to these differences, *croceum* and *silaceum* show relevant differences in the genital appendages, i.e., *cro-*

*ceum* has the tip of the aedeagus with longer apical tooth and thicker stipes (Figs. 158 & 163). Since the two species appear to be sympatric in a number of States where they have been sometimes collected even in the same county (e. g. Union Co, Tennessee), there are no doubts about the opportunity of their distinction.

DISTRIBUTION: United States: Illinois, Oklahoma, Arkansas, Tennessee, Mississippi, Alabama, Louisiana, Virginia, North Carolina, South Carolina, Texas, Georgia, Florida. Other state records from the literature but not verified by ourselves are not included. Most of them, however, appear perfectly plausible.

### ***Proceratium silaceum* Roger**

Figs. 2, 159, 160, 161, 162, 163, 164

*Proceratium silaceum* Roger, 1863: 172. Worker. Original description. Type locality: North America. Type material: holotype worker labelled: "Nord-America, TYPE, *silaceum* Rog., *Proceratium silaceum*, Zool. Mus. Berlin"; in ZMBC, examined.

*Proceratium crassicorne vestitum* Emery, 1895: 266 Worker. Original description. Type locality: Charlton Heights, Maryland, USA. Type material: holotype worker labelled: "Charlton Heights, Sept. 24.91, *vestitum*", in MCSN, examined. Synonymy with *silaceum* by Creighton, 1950: 40.

*Proceratium silaceum rugulosum* Wheeler, 1915: 390. Worker and gyne. Original description. Type locality: Wyandotte, Indiana, USA. Type material: two workers and one gyne (syntypes) partially labelled: "Wyandotte, Ind, W. Blatchley", in MCZC and USNM, examined. Synonymy with *silaceum* by Creighton, 1950: 40.

*Proceratium silaceum* Roger, Kennedy & Talbot, 1939: 202. Male and male genitalia.

*Proceratium silaceum* Roger, Creighton, 1950: 40. Partim

*Proceratium silaceum* Roger, Krafchick, 1959: pl. II fig. 9, pl. III fig. 12, pl. IV fig. 9. Male genitalia.

*Proceratium silaceum* Roger, Crozier, 1970: 116. Karyotype.

*Proceratium mancum* Mann, Brown, 1974: 82. Partim. Nec Mann, 1922. Misidentification.



DIAGNOSIS. A *Proceratium* species belonging to the *silaceum* clade and differing from the other three North American species of this clade, *croceum*, *mancum* and *crassicorne*, by the following characters: from *croceum* only, in the worker, gyne and male, by the thicker petiole, stronger sculpture and by the larger size (worker TL > 3.7 mm, gyne TL > 5.1 mm, male TL > 4.0 mm, instead of worker TL < 3.5 mm, gyne TL < 4.1 mm, male TL < 3.3 mm); from *crassicorne* only in the worker, gyne and male, by the sculpture more impressed, in the worker and gyne by the frontal carinae broader and by the hairs of type (1) sparser on the gaster, in the gyne only, by the EL  $\geq$  0.19 mm instead of  $\leq$  0.17 mm; from *mancum* only, in the worker and gyne by the posterior half of the head dorsum more sculptured and by the legs with much shorter hairs.

DESCRIPTION. *Worker* (Figs. 2, 159 & 160). Head slightly longer than broad or almost as long as broad and with subparallel sides. Vertex in full face view straight or weakly convex. Clypeus reduced, as long as or slightly longer than the antennal sockets. Anterior border of the clypeus truncate. Frontal carinae far from each other, poorly covering the antennal insertions. Lateral expansions of the frontal carinae not very broad, weakly raised, diverging on the two anterior fourths, converging on the third fourth, diverging and carinate only on the last fourth. Frontal area gently concave and with a median, longitudinal carina starting on the posterior fourth and prolonging posteriorly. Head anterolaterally with a variably marked longitudinal carina. Genal carinae marked, each carina corresponding to the external border of a deep sulcus. Eyes visible as a dark dot below the integument, small and placed on the middle of the head sides. First funicular joint almost as long as broad or slightly longer than broad. Funicular joints 2-10 broader than long. Last funicular joint as long as the sum of joints 6-10 or slightly longer than the sum of joints 7-10. Scapes not reaching the vertexal margin posteriorly and gently thickening apically. Masticatory margin of the mandibles with 7-11 denticles before the pointed apical tooth. Palp formula 2,2.

Mesosoma in side view weakly convex on the two anterior thirds, gently sloping on the posterior third. Pronotal and propodeal sutures superficially impressed. Basal face of the propodeum declivous posteriorly. Area between the basal and declivous faces of the propodeum gently concave, dorsally variably carinate and laterally with a triangular tooth. Declivous face

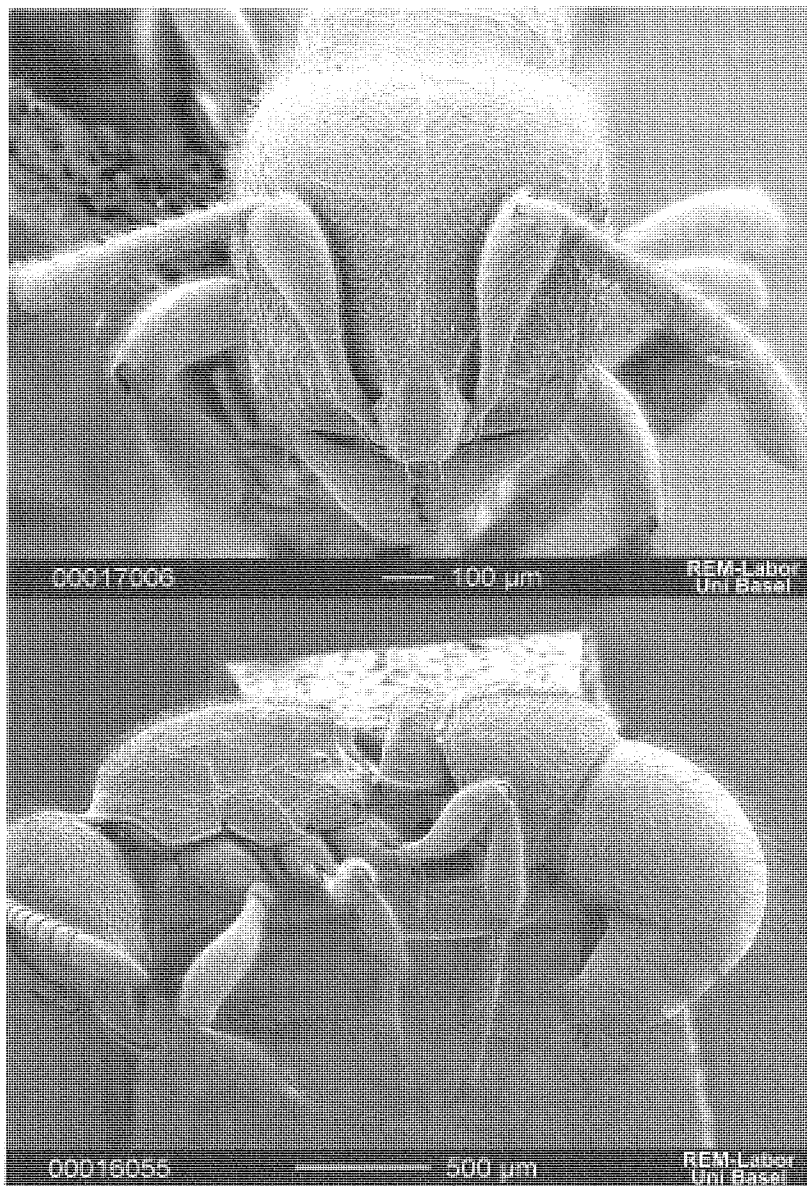


Fig. 159 – *Proceratium silaceum* Roger. Worker from Lawrence Co, Spring Mill State Park, Indiana, USA: head (top) in dorsal view and meso- and metasoma (bottom) in side view.

of the propodeum gently sloping posteriorly. Sides of the declivous face of the propodeum carinate. Propodeal spiracle round and above mid height in lateral view.

Petiole subrectangular, broad. Anterior border of the petiole straight and anterolaterally carinate. Petiole in dorsal view with the posterodorsal border of the node superficially carinate. Ventral process of the petiole large, lamelliform and pointed posteriorly. Postpetiole in dorsal view with the sides diverging on the anterior half and gently convex on the posterior half. Postpetiolar sternite anteromedially with a marked subtriangular projection, gently convex posteriorly in side view. Constriction between postpetiole and gaster impressed. Gastral tergite I about 1/3 longer than the postpetiole and convex on the curvature. Remaining gastral tergites and sternites curved ventrally.

Legs moderately elongate. All tibiae with a pectinate spur. Spurs of fore legs without basal spine. Fore basitarsi longer than the mid ones. Hind basitarsi about 1/5 shorter than hind tibiae. Second tarsomere of hind legs shorter than pretarsus. Pretarsal claws simple. Arolia absent.

Sculpture. Head, mesosoma, petiole and postpetiole minutely punctate, reticulorugose, the reticulation and rugosities larger on the sides of the head, the rugosities variably impressed on the petiole and postpetiole. First gastral tergite smooth and with minute piligerous punctures. Legs punctate.

Body covered by hairs of three types: (1) short, suberect or subdecumbent but less dense than in *crassicorne*, erect and sparse on the funicular joints; (2) longer than type (1), erect on the whole body, slightly longer on the gaster, absent on the funiculi; (3) shorter than hair type (1), dense and decumbent on the funicular joints only. In addition the funicular joints bear whitish, thick, appressed, sparse hairs, and the scapes with sparse hairs similar to type (2) but slightly shorter.

Colour. Light or dark ferruginous-brown with slightly lighter antennae and legs.

Measurements in mm and Indices: TL 2.56-3.40; HL 0.59-0.74; HW 0.56-0.72; EL 0.03-0.05; SL 0.38-0.51; WL 0.69-0.94; PeL 0.18-0.25; PeW 0.25-0.38; HFeL 0.42-0.61; HTiL 0.35-0.49; HBaL 0.25-0.40; LS4 0.31-0.43; LT4 0.55-0.78; CI 94.9-98.5; SI 64.4-68.9; IGR 0.51-0.56.

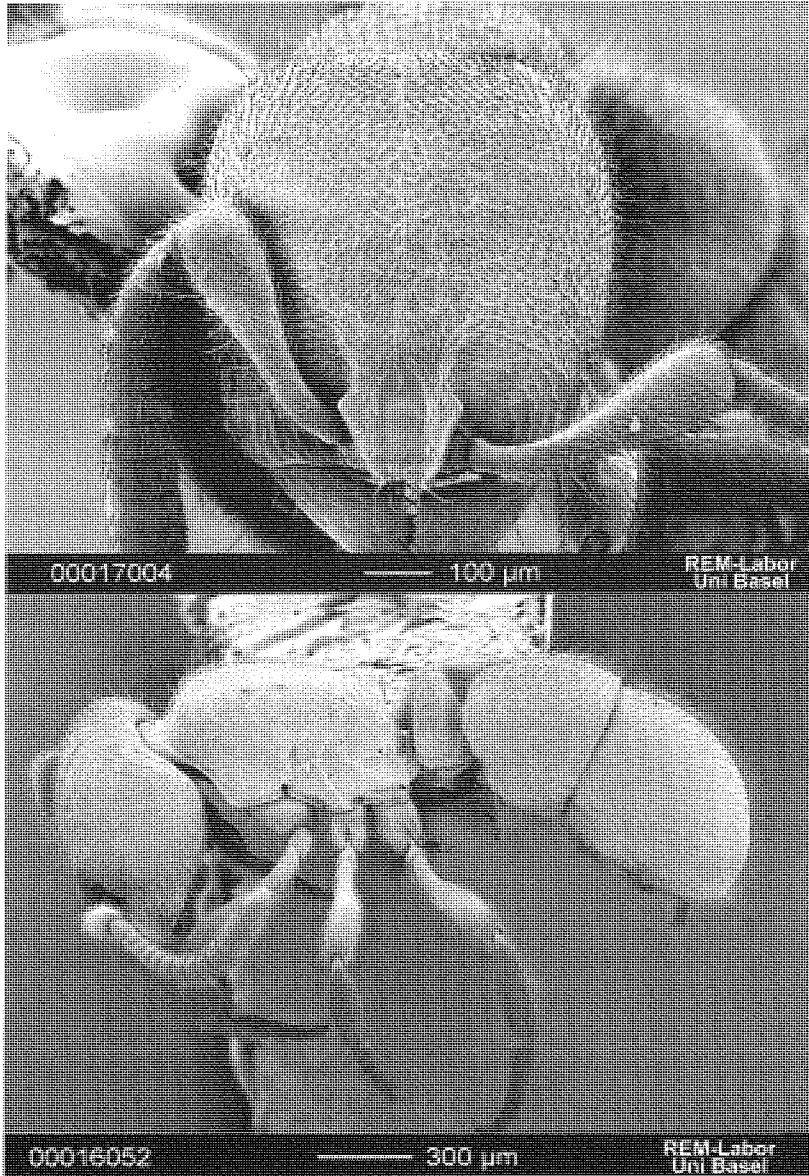


Fig. 160 – *Proceratium silaceum* Roger. Worker with “*vestitum*” morphology from Calvert Co. 9 km S Prince Frederick, Maryland, USA: head (top) in dorsal view and meso- and metasoma (bottom) in side view.

*Gyne*. Differing from the worker in the following details: eyes large, about 1/4 of the head length, composed by many facets and with ocular pilosity. Ocelli well developed.

Mesosoma robust and gently convex in side view. Parapsidal furrows marked. Scutellum with the sides converging posteriorly and with the posterior border subtruncate. Posterior half of the dorsum of the mesonotum and scutellum with a longitudinal carina more marked posteriorly. Metanotum with a small tooth. Basal face of the propodeum almost flat laterally and gently concave medially.

Fore wings of our type 4, hind wings of our type 3 as defined in the description of the genus (Fig. 161).

Colour. As in the worker but some specimens with a dark brown macula on the posterior part of the head, on the mesosoma and on the postpetiole.

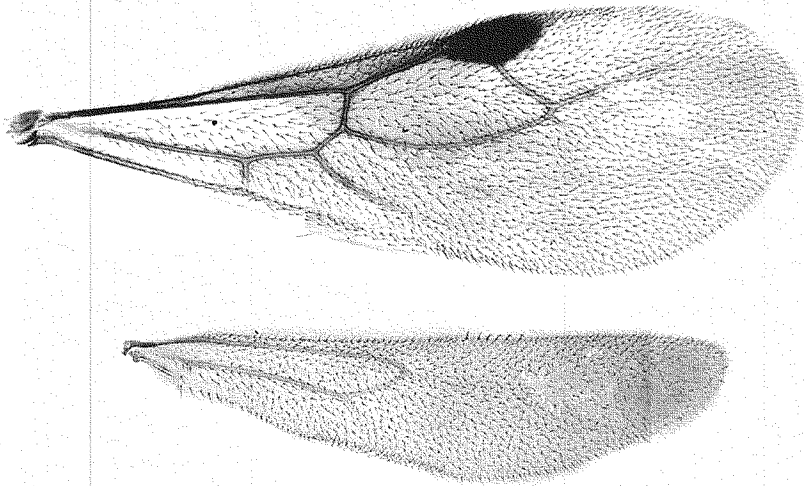


Fig. 161 – *Proceratium silaceum* Roger. Gyne from Shoal Creek, Jackson City, North Carolina, USA: Fore and hind wings.

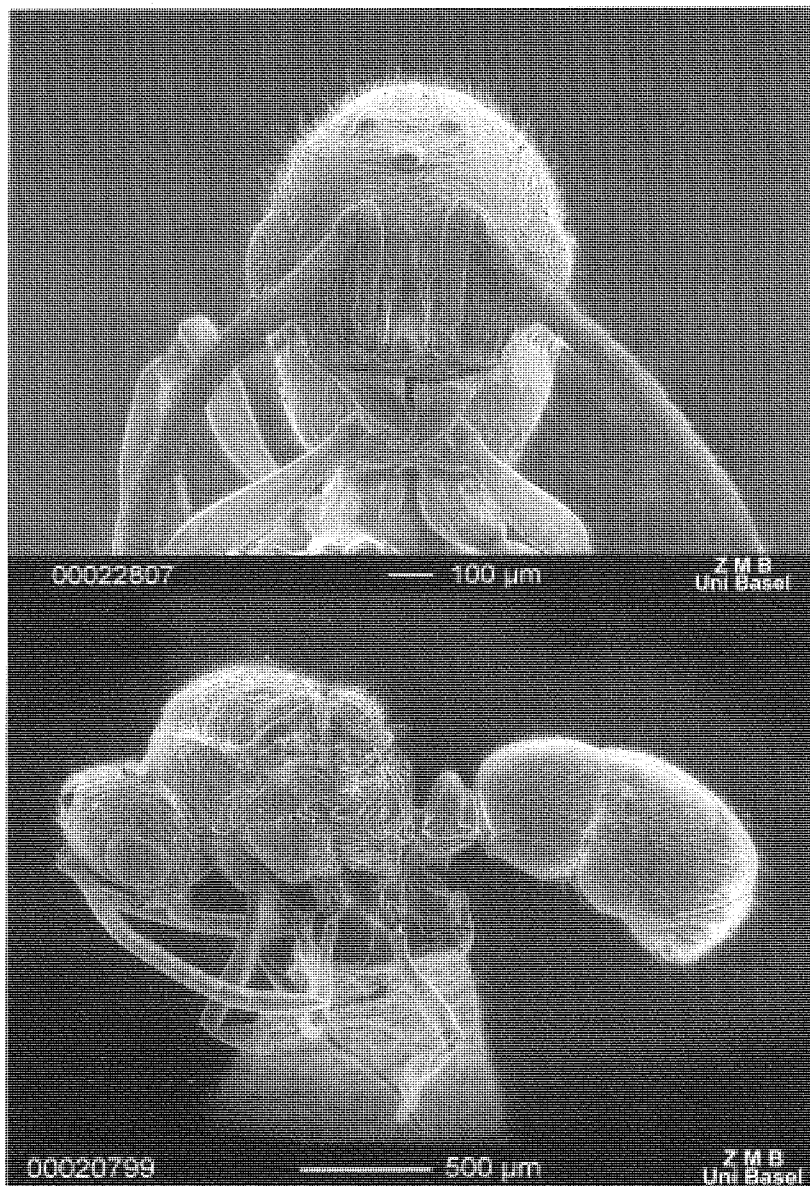


Fig. 162 – *Proceratium silaceum* Roger. Male from Chillhowee Mountains, Tennessee, USA: head (top) in dorsal view and meso- and metasoma (bottom) in side view.

Measurements in mm and Indices: TL 3.40-4.05; HL 0.69-0.81; HW 0.64-0.78; EL 0.19-0.22; SL 0.43-0.54; WL 0.96-1.14; PeL 0.22-0.26; PeW 0.34-0.41; HFeL 0.53-0.68; HTiL 0.43-0.55; HBaL 0.34-0.46; LS4 0.43-0.53; LT4 0.82-0.97; CI 94.1-98.5; SI 63.2-69.2; IGR 0.51-0.56.

*Male* (Fig. 162). Head slightly broader than long. Vertex in full face view strongly convex. Vertexal margin superficially carinate. Clypeus reduced, truncate and slightly longer than the antennal sockets. Frontal carinae thin, low and parallel. Frontal area with a round or obtuse swelling anteriorly, concave posteriorly. Ocelli large. Compound eyes large and mostly on the anterior part of the head sides. Scapes short of the anterior ocellus posteriorly. First funicular joint slightly shorter than the second. Joints 2-12 longer than broad. Last funicular joint slightly longer than the sum of joints 10-11. Mandibles edentate and only with a pointed apical tooth. Palp formula 5,2.

Mesosoma robust and convex in profile. Pronotum and anterior third of mesonotum almost perpendicular to the posterior two thirds of the mesonotum. Parapsidal furrows marked. Scutellum weakly convex in side view; posterior border of scutellum round; dorsum of the scutellum with a longitudinal carina prolonging up to the mesonotum. Basal face of the propodeum slightly declivous and medially with a variably impressed incision prolonging up to the anterior part of the declivous face. Sides between basal and declivous faces of the propodeum subangulate. Declivous face of propodeum flat. Metanotum with a median, broad, spiniform tooth. Lower part of the propodeal lobes obtuse and upper part round and partially lamelliform. Propodeal spiracles small.

Petiole in side view with declivous anterior face, the node scale-like. Anterior border of the petiole laterally weakly carinate. Subpetiolar process small, triangular. Postpetiole anteriorly broader than the petiole; postpetiolar sides convex. Anterior border of the postpetiolar sternite with a superficial triangular "lip". Gastral tergite I convex in side view. Gastral sternite I large. Remaining gastral tergites and sternites slightly curved ventrally.

Legs as in the worker but more elongate. Hind basitarsi slightly shorter than hind tibiae.

Fore wings of our type 4, hind wings of our type 3 as defined in the description of the genus.

Genitalia as in Figs. 163 & 164.

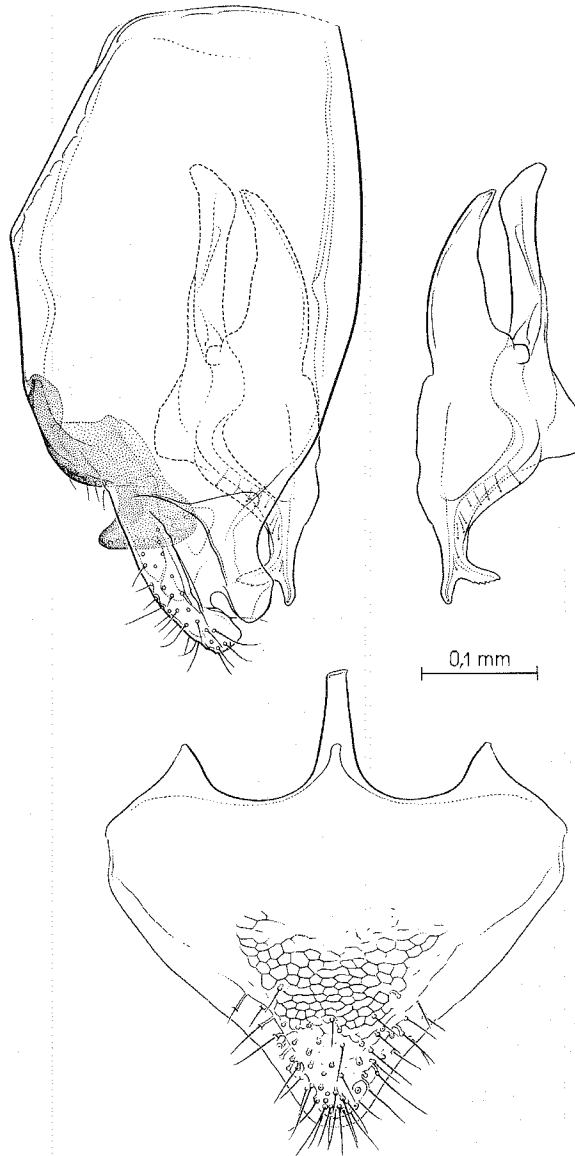


Fig. 163 – *Proceratium silaceum* Roger. Male from Chilhowee Mountains, Tennessee, USA. Genital appendages: a) lateral view of left parameres and of their relative positions; b) right aedeagus in profile; c) subgenital plate in ventral view.



Sculpture. Head and mesosoma reticulate-punctate, irregularly and variably rugulose, the rugosities longer and longitudinal on the posterior half of the mesonotum and on the scutellum, the reticulation broader on the basal face of the propodeum. Petiole, postpetiole and gaster smooth and with minute piligerous punctures. Legs smooth and minutely punctate.

Pilosity as in the worker.

Colour. Black with slightly lighter legs, antennae and mandibles.

Measurements in mm and Indices: TL 2.84-3.15; HL 0.52-0.59; HW 0.53-0.60; EL 0.26-0.28; SL 0.26-0.29; WL 0.99-1.04; PeL 0.17-0.21; PeW 0.22-0.30; HFeL 0.56-0.62; HTiL 0.42-0.47; HBaL 0.40-0.42; LS4 0.36-0.43; LT4 0.65-0.75; CI 101.7-103.6; SI 47.4-51.8; IGR 0.55-0.57.

MATERIAL EXAMINED: CANADA: ONTARIO: Pelee Island, 5 workers, 2 males, C. H. Kennedy [USNM]; same locality, 23.VIII.1936, 2 workers 1 male, C. H. Kennedy [LACM]; Lake Rowan Vic., under bark living pine tree, 2 workers, 2 gynes, 2 males [MCZC]. UNITED STATES: no further locality, 1 worker (holotype) [ZMBC]. NEW YORK: Bergen Swamp, Genesee, 1 worker, K. W. Cooper [USNM]; Staten Island, 10.XI.1907, 1 worker, Wm. T. Davis [USNM]. PENNSYLVANIA: no further locality, 1 worker, Pergande [MNHN]; no further locality, 1 gyne, Schmitt [NHMW]; Beatty, 18.V and other dates, 12 workers, 3 gynes, Schmitt (one pin only with collectors' name) [MCSN, USNM]; near Frankford, 2.V.1939, in rotten stump, 12 workers, W. L. Brown [MIZA, USNM]; Frankford, 9.III.1940, 6 workers, 1 gyne, 1 male, W. L. Brown [USNM]; Harrisburg, 1 worker, H. Surface [USNM]. ILLINOIS: Mound City, 4 workers, Roos & Mohr [USNM]; same locality, 24.II.1933, 3 workers, Ross & Mohr [USNM]; Havana, XI.1943, 3 workers, Ross & Sanderson [USNM]; Edgemont, 16.IX.1943, 1 worker, W. E. Snow [USNM]; Magnolia, 23.III.1944, 2 workers, 1 gyne, H. H. Ross [USNM]. OHIO: Center College, 6.V.1938, 8 workers, C. H. Kennedy [LACM]. MARYLAND: Charlton Heights, 24.IX.1891, 1 worker (holotype of *crassicornis vestitus*) [MCSN]; same locality and date, 1 gyne, 1 male [USNM]; Plummers Island, 23.VIII.1919, 2 gynes, Schwartz & Barber [USNM]; Hope House, Talbot Co., 6.IX.1945, 1 gyne, E. A. Chapin [USNM]; Synepuxent, Worcester Co., VIII.1966, 1 worker, 1 male, W. L. Brown [USNM]; Pr. Georges Co., Patuxent Wildlife Refuge, 16.VI.1968, field no. 1968-79, 3 workers, R. R. Snelling [LACM]; Calvert Co., 9 km S Prince Frederick, 2.V.1987, 7 workers, G. J. Umphrey [MIZA]. WASHING-

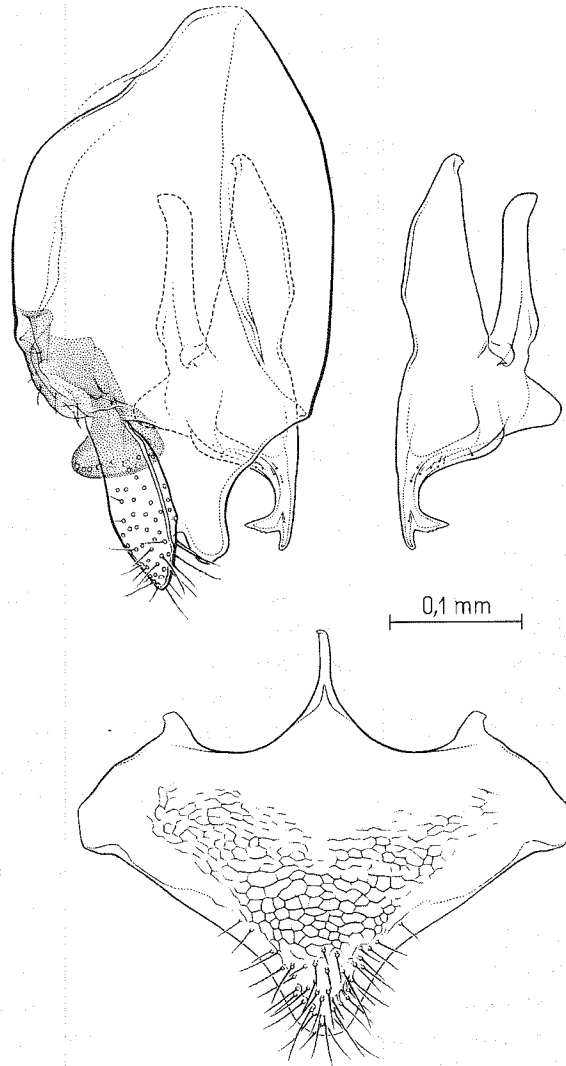


Fig. 164 – *Proceratium silaceum* Roger. Male with “*vestitum*” morphology from Lake Rowan, Ontario, Canada. Genital appendages: a) lateral view of left parameres and of their relative positions; b) right aedeagus in profile; c) subgenital plate in ventral view.

TON DC: June 5, 1 worker, Pergande [MNHN]; same locality 18.VII.1948, 1 worker, F. Bonet [MZSP]. INDIANA: Wyandotte, 2 workers and 1 gyne (all syntypes of *silaceum rugulosum*), Wm. Blatchley [MCZC, USNM]; Crawford, 1 worker, 7.VI.1905, W. S. B. [USNM]; Lawrence Co., Spring Mill State Park, 7.XI.1971, 3 workers, R. F. Wilkey & J. A. McBride [LACM]; Lafayette, 28.IX.1935, 1 worker, A. C. Cole [LACM]. MISSOURI: Barry Co., Ozark Mts, 8,7 mi S Junction RT 76/86 on Rt 112 at FSR 1037, 17& 20.V.1996, elevation near 1000', 30 workers, 3 gynes, S. P. Cover [MCZC]. VIRGINIA: Falls Church, Sept. 3 workers, 1 gyne [USNM]; same locality, 13.IV.1919, 1 gyne, E. A. Chapin [USNM]; same locality, 29.IV.1923, 3 workers, E. A. Chapin [USNM]; Mt Vernon, 14.VIII.1919, 1 worker, L. L. Buchanan [USNM]; Black Pond, 1 worker, [2 upper workers on the same pin = *crassicorne*] [USNM]; Black Pond, Fairfax Co., 1 worker, 1 gyne, H. S. Barber [MCZC]; same locality, 27.VIII.1919, 1 gyne, C. T. Greene [USNM]; Great Falls, 5.VII.1924, 1 worker, E. A. Schwartz [USNM]; same locality, 16.VIII.1929, 1 gyne, H. S. Barber [USNM]; Richmond, 5.IX.1932, 1 worker, H. T. Vanderford [USNM]; Creeds, 1936, 2 workers, 1 gyne, W. M. Mann [USNM]; Pine Crest, 22.V.1938, 3 gynes, M. R. Smith [USNM]. OKLAHOMA: Latimer Co., III.1985, 2 workers, K. Stephan [FSCA, UCFC]; same locality, III.1988, 1 worker, K. Stephan [FSCA]. ARKANSAS: Montgomery Co., Cristal, Quacita Natural Forest, 6.III.1992, 1 worker, C. Carlton & H. Robison [ABSC]; Polk Co., Bard Springs, Quachita Natural Forest, 24.IV.1992, 4 workers, C. Carlton & H. Robison [ABSC]; Montgomery Co., Quachita Natural Forest, 16.V.1992, 2 workers, H. Robison & C. Carlton [ABSC]. TENNESSEE: Union Co., 24.V.1947, 1 gyne, 1 male, Pfitzer [LACM]; Coffee Co. near Manchester, 2-3.VIII.1947, 18 workers, D. W. Pfitzer [MZSP, USNM]; Manchester, 3.VIII.1947, 2 workers, Pfitzer [LACM]; Univ. Farm, Knoxville, 15.V.1947, 6 workers, J. W. Jones [USNM]; Greenbrier Cove, Smoky Mountain, 13.II.1938, 1 gyne, A. C. Cole [LACM]; Chilhowee Mts., Servier Co., 23-25.VIII.1950, 3 workers, 7 males, A. C. Cole [LACM]. NORTH CAROLINA: Faisons, 1 gyne [MHNG]; Shoal Creek, Jackson City, 31.VII.1968, 4 workers, 1 gyne, 1 male, W. L. Brown [MCZC]. SOUTH CAROLINA: Clemson, 10.XII.1938, 1 gyne, O. L. Cartwright [USNM]; CCC Camp F2, Oconee Co., 30.VIII.1938, 21.VII.1939, 1 worker, 1 gyne, O. L. Cartwright [USNM]; Charleston, 28.VII.1930, 2 workers, D. Ercad [USNM]. MISSISSIPPI: no further locality, 1 gyne [USNM]; Bond, 2 workers, L. C. Murphree [USNM]; Holly

Springs, 1 worker, L. C. Murphree [USNM]; Corinth, 1 gyne, M. R. Smith [USNM]; Columbus, 2 workers, 1 gyne, [WEMC]; same locality, 7 workers, 1 gyne, M. R. Smith [LACM, USNM]; same locality, 28.III.1929, 1 gyne [USNM]; Ripley, 19.VII.1930, 1 worker, S. W. Simmons [USNM]; Starkville, 17.IX.1930, 1 worker, E. E. Byrd [WEMC]; Oktibbeha Co., Noxubee Refuge, 21.VII.1981, 1 gyne, L. R. Brown [MCZC]. ALABAMA: 8 mi N of Mobile, 23.VI.1929, 1 worker, W. S. Creighton [LACM]; Spring Hill, Mobile, 22 & 31.V.1929, 3 workers, W. S. Creighton [LACM]; Jackson's Oak, Baldwin Co., 9.VI.1929, 6 workers, W. S. Creighton [LACM, USNM]; Dauphin I., Mobile Co., 10.IX.1959, 1 worker, W. Suter [LACM]. GEORGIA: Ft Gordon, Richmond Co., 15.XI.1958, 1 gyne, R. R. Snelling [LACM]. FLORIDA: Cave St Park, 9.IX.1968, 2 workers, S. Peck [MCZC]; 5.5 mi N Gainesville, 5.IV.1992, 4 workers, L. R. Davis Jr. [CPCC]; Tallahassee, Leon Co., 5.VII.1990, 3 workers, 1 gyne, M. Deyrup [UCFC]; Wekiwa Springs St. Park, Apopka, Orange County, 6.XII.1993, hardwood hammock, 3 workers, Z. Prusak [UCFC]; Okaloosa Co., Eglin AFB, 22 & 26.IV.1999, 3 workers, S. P. Cover [MCZC]; Walton Co., Eglin AFB, 24.IV.1999, 8 workers, 1 gyne, S. P. Cover [MCZC]; Alachua Co., 5.5 miles W Gainesville, 8 & 26.IV.1992, in pine log, 4 workers, 1 gyne, L. R. Davis Jr. [MCZC]; Alachua Co., Gainesville, 26.II.1993, 5 workers, L. R. Davis Jr. [LACM, MCZC]; Alachua Co., along SW 75<sup>th</sup> St. (Tower Road), 25 miles N rt. 24, 20.II.1995, malaise trap, rock creek, 1 gyne, L. R. Davis Jr. [MCZC]; Alachua Co., Gainesville, 15.VII-15.VIII.1983, 1 gyne, S. Gupta [ABSC]; Putnam Co., 3 miles E of Melrose, Ordway Preserve, 8.I & 3.III.1995, 6 workers, 3 gynes, L. R. Davis Jr. [ABSC, MCZC, MRSN]; Baker Co., Olustee Tower, 2.5 miles E Olustee along rt. 90, in pine log, 17.V.1992, 2 workers, L. R. Davis Jr. [MCZC]; Baker Co., Sanderson, 9.X.1993, 1 gyne, L. R. Davis Jr. [ABSC]; Baker Co., Osceola Nat. Forest, 11.VII.1993, oak hammock on old sand rd near Columbia Co. Line, 1 worker, M. Deyrup [ABSC]; Parker Islands, Highlands Co., 15.I.1987, 3 workers, W. Suter [ABSC]; Niceville, Okaloosa Co., 28.XII.1988, swamp litter, 1 gyne, W. Suter [ABSC]; Univ. W. Florida, Escambia Co., 7.VII.1992, 1 worker, M. Deyrup [ABSC]; Union Co., Lake Butler, 22.X.1993, 1 worker, L. R. Davis Jr. [ABSC]; Archbold Biological Station, Lake Placid, Highlands Co., 2.II.1984, 1 worker, M. Deyrup [ABSC]; Kingsley Village, along rt 16, Clay Co., 26.III.1993, 4 workers, L. R. Davis Jr. [ABSC]; Washington Co., Falling Waters S. Park, 6.V.1997, 4 workers,

P. W. Kovarik [ABSC]; Liberty Co., Apalachicola Nat. Forest, 14.V.2000, 5 workers, 1 gyne, M. Deyrup & S. Cover [ABSC]; Brevard Co., Indian R. City, 28.II.2001, 1 gyne, M. Deyrup & S. Cover [ABSC]; Lafayette Co., 1.2 miles W Suwannee River, jct rt 27 and rt 349, 23.IV.1993, 1 worker, L. R. Davis Jr. [ABSC].

DISCUSSION. Wesson & Wesson (1940) from 1934 to 1939 within 45 miles from Jackson (Ohio) collected *silaceum* seven times in open woods in stumps or logs.

*Proceratium silaceum* appears to be a variable species. Creighton (1950) synonymized with it *crassicornis vestitum* Emery. We were able to find a few differences between "true" *silaceum* and *vestitum* but these appear to be inconsistent over large series. The Figs. 160 and 164 refer to "*vestitum*". The "*ssp. vestitum*" appear to differ from *silaceum* in the following: size slightly smaller, sculpture on the mesosoma, petiole and postpetiole less marked, petiole slightly thinner, funicular joints shorter. Since these characters fit to a majority of specimens only we concur with Creighton (l. c.) in considering *vestitum* as a synonym of *silaceum*. On the contrary we do not agree to treat *P. crassicornis* (q. v.) as a junior synonym of *silaceum* as proposed by Creighton (1950). The differences between the two species as described under *crassicornis*, however small, are constant in all the specimens of the two species that we examined. Similar considerations apply to the synonymy with *silaceum* of *P. mancum* Mann proposed by Brown (1974). The differences between the two species are given in our treatment of *mancum* (q. v.).

DISTRIBUTION: Canada (Pelee Island, Ontario), United States: New York, Pennsylvania, Illinois, Ohio, Maryland, Washington D. C., Indiana, Missouri, Virginia, Oklahoma, Arkansas, Tennessee, North Carolina, South Carolina, Mississippi, Alabama, Georgia, Florida. Other state records from the literature but not verified by ourselves are not included. Most of them, however, appear perfectly plausible.

**Proceratium crassicorne** Emery, revived status

Figs. 165, 166, 167

*Proceratium crassicorne* Emery, 1895: 265, pl. 8, fig. 9. Worker. Original description. Type locality: District of Columbia, USA. Type material: two syntype workers labelled: "Corcoran Hill, D.C., July 26-9, no. 175, *Proceratium crassicorne*, n. sp.", in MCSN; ten workers same data as the syntypes and probably belonging to the type series, but not examined by Emery, 2 workers in MCZC and 7 workers in USNM (all USNM pins labelled as Cotypes no. 53577), examined.

*Proceratium silaceum* Roger, Creighton, 1950: 40. Partim. Nec Roger 1863.

*Proceratium crassicorne* Emery, Wheeler & Wheeler, 1952: 137. Pl. v figs. 17-19. Larva.

DIAGNOSIS. A *Proceratium* species belonging to the *silaceum* clade, similar to *silaceum* but differing from it, in the worker, gyne and male, by the sculpture less impressed, in the worker and gyne by the frontal carinae narrower and by the hairs of type (1) denser on the gaster, in the gyne only by the eyes smaller ( $\leq 0.17$  mm instead of  $\geq 0.19$  mm).

DESCRIPTION. *Worker* (Fig. 165). Head slightly longer than broad with the sides gently diverging posteriorly. Vertex in full face view gently convex. Clypeus reduced and as long as the antennal sockets. Anterior border of the clypeus truncate. Frontal carinae closer to each other than in *silaceum*. Lateral expansions of the frontal carinae less broad than in *silaceum*, slightly raised, diverging on the two anterior fourths, gently converging on the third fourth and subparallel on the last fourth. Frontal area gently concave, posteriorly with a median, longitudinal carina prolonging backwards. Head anterolaterally with a variably marked longitudinal carina. Genal carinae marked, each carina corresponding to the external border of a deep sulcus. Eyes visible as a dark dot below the integument, small and placed on the middle of the head sides. First funicular joint slightly longer than broad. Funicular joints 2-10 broader than long. Last funicular joint slightly longer than the sum of joints 7-10. Scapes short of the vertexal margin and gently thickening apically. Masticatory margin of the mandibles with 7-8 denticles before the pointed apical tooth. Palp formula 2,2.

Mesosoma in side view weakly convex on the two anterior thirds, gently sloping on the posterior third. Pronotal and propodeal sutures absent. Basal face of the propodeum declivous posteriorly. Area between the basal and declivous faces of the propodeum gently concave dorsally and variably cari-

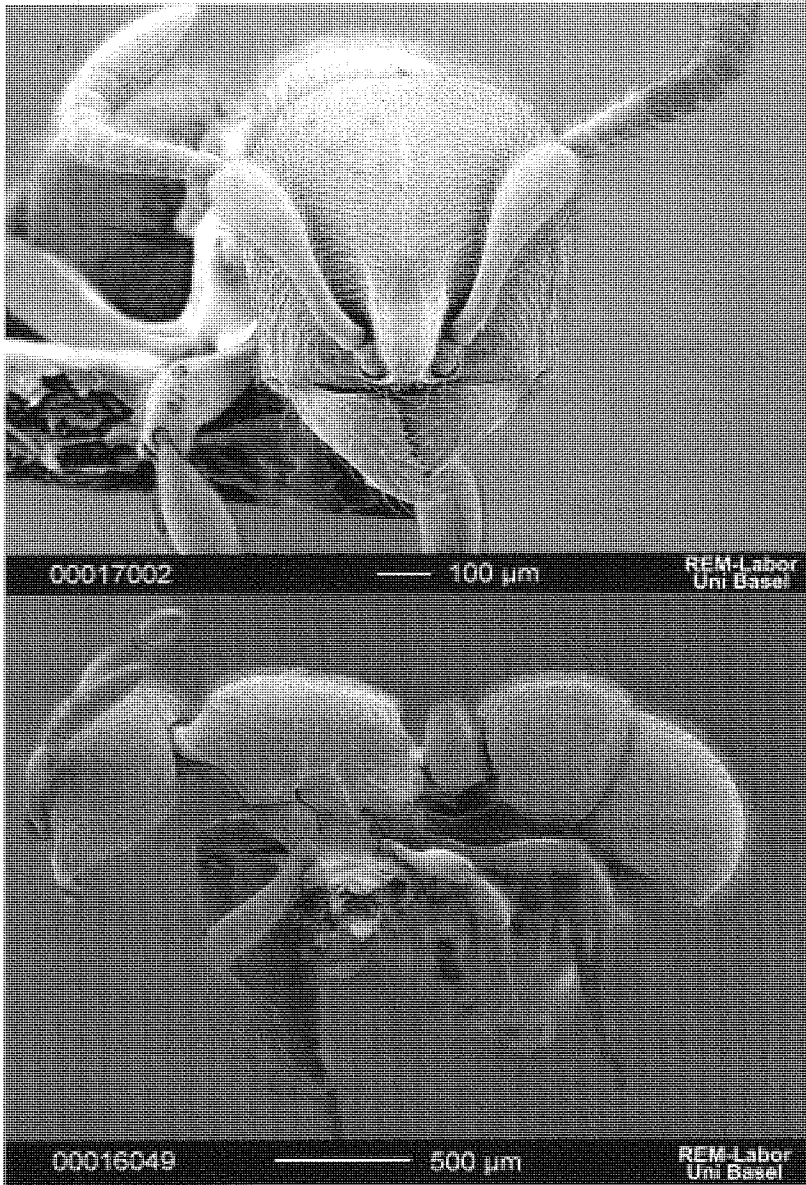


Fig. 165 – *Proceratium crassicorne* Emery. Worker from Myles Standish State Forest, Massachusetts, USA: head (top) in dorsal view and meso- and metasoma (bottom) in side view.

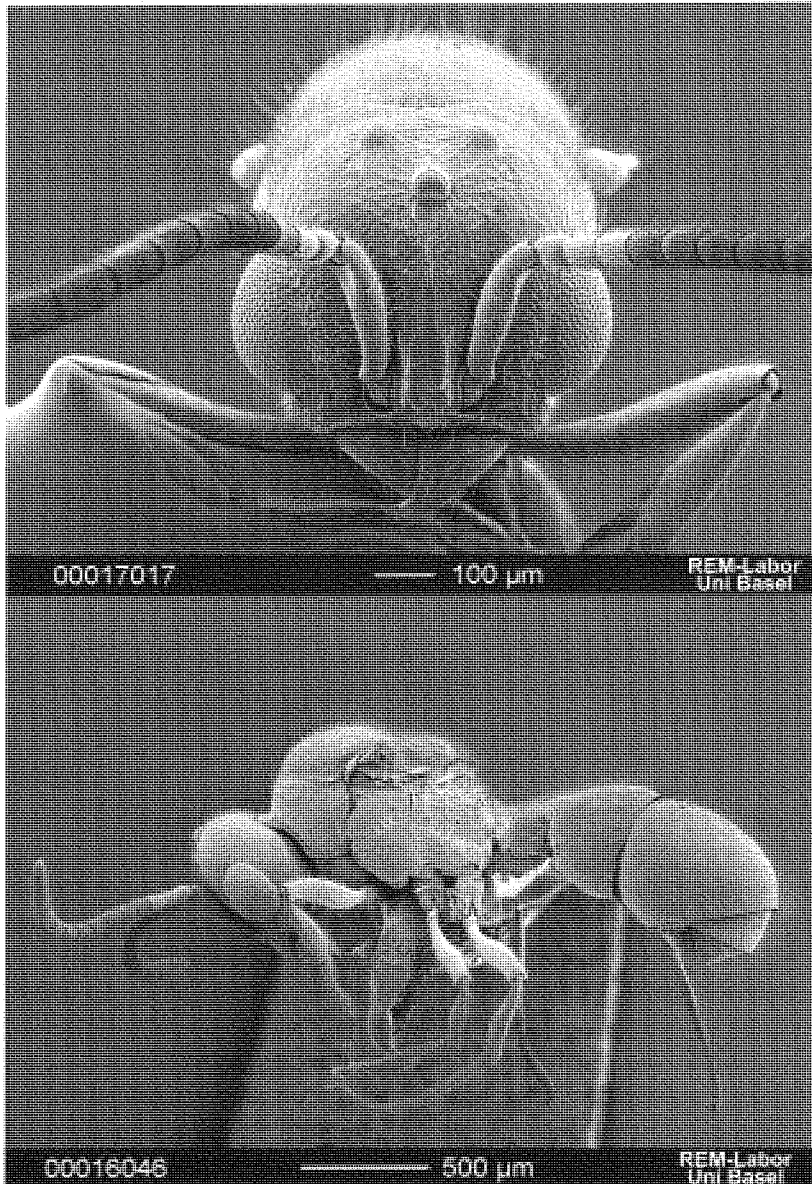


Fig. 166 – *Proceratium crassicorne* Emery. Male from Fairfax Co., near Annandale, Virginia, USA: head (top) in dorsal view and meso- and metasoma (bottom) in side view.



nate. Each side between the basal and declivous faces of the propodeum with a tooth. Declivous face of the propodeum gently sloping posteriorly. Sides of the declivous face of the propodeum carinate. Propodeal spiracle round and above mid height in lateral view.

Petiole subrectangular. Anterior border of the petiole straight and anterolaterally narrowly marginate. Ventral process of the petiole lamelliform and pointed posteriorly. Postpetiole in dorsal view with the sides diverging on the anterior half and gently convex on the posterior half. Postpetiolar sternite anteromedially with a marked subtriangular projection, gently convex posteriorly in side view. Constriction between postpetiole and gaster impressed. Gastral tergite I about 1/3 longer than the postpetiole and convex on the curvature. Remaining gastral tergites and sternites curved ventrally.

Legs moderately elongate. All tibiae with a pectinate spur. Spurs of fore legs without basal spine. Fore basitarsi longer than the mid ones. Hind basitarsi about 1/4 shorter than the hind tibiae. Second tarsomere of hind legs shorter than pretarsus. Pretarsal claws simple. Arolia absent.

Sculpture. Head, mesosoma, petiole and postpetiole minutely punctate, reticulorugose, the reticulation and the rugosities larger on the sides of the head, the rugosities absent on the petiole and postpetiole. First gastral tergite smooth and with minute piligerous punctures. Legs punctate.

Pilosity as in *silaceum* but with hairs of type (1) better covering the integument and hairs of type (2) slightly sparser and shorter.

Colour. Dark yellow to light brown with slightly lighter antennae and legs.

Measurements in mm and Indices: TL 2.74-3.03; HL 0.62-0.67; HW 0.58-0.64; EL 0.02-0.04; SL 0.41-0.44; WL 0.74-0.83; PeL 0.19-0.20; PeW 0.26-0.29; HFel 0.44-0.49; HTiL 0.37-0.41; HBaL 0.28-0.31; LS4 0.30-0.35; LT4 0.62-0.69; CI 92.1-95.5; SI 64.5-66.1; IGR 0.48-0.54.

*Gyne*. Differing from the worker in the following details: eyes large but smaller than in *silaceum*, about 1/4 of the head length, composed by many facets and with ocular pilosity. Ocelli well developed.

Mesosoma robust and gently convex in side view. Parapsidal furrows marked. Scutellum with the sides converging posteriorly and with the poste-

rior border subtruncate. Scutellum with a longitudinal ruga, the ruga sometimes prolonging only to the posterior half of the mesonotum but very superficial. Metanotum with a small tooth. Basal face of the propodeum almost flat laterally and concave medially.

Fore wings of our type 4, hind wings of our type 3 as defined in the description of the genus.

Colour. As in the worker but with a dark brown macula on the posterior part of the head, on the mesosoma and on the postpetiole.

Measurements in mm and Indices: TL 3.20-3.45; HL 0.63-0.68; HW 0.62-0.65; EL 0.15-0.17; SL 0.41-0.44; WL 0.90-0.98; PeL 0.20-0.22; PeW 0.31-0.35; HFeL 0.48-0.54; HTiL 0.40-0.43; HBaL 0.31-0.35; LS4 0.35-0.42; LT4 0.69-0.85; CI 95.6-98.4; SI 64.7-65.1; IGR 0.47-0.51.

*Male* (Fig. 166). Head slightly broader than long. Vertex in full face view broadly convex. Vertexal margin superficially carinate. Clypeus reduced, truncate and slightly longer than the antennal sockets. Frontal carinae thin, low and parallel. Frontal area with a subround tumulus anteriorly, concave posteriorly, the concavity convergent posteriorly. Ocelli large. Compound eyes large and placed mostly on the anterior part of the head sides. Scapes short of the anterior ocellus posteriorly. First funicular joint subequal to the second joint. Joints 2-12 longer than broad. Last funicular joint as long as or slightly shorter than the sum of joints 9-11. Mandibles edentate and only with a pointed apical tooth. Palp formula 5,2.

Mesosoma robust and convex in side view. Pronotum and anterior third of mesonotum almost perpendicular to the posterior two thirds of the mesonotum. Parapsidal furrows marked. Scutellum in side view convex; posterior border of scutellum round; dorsum of scutellum with a longitudinal carina prolonging up to the mesonotum. Basal face of the propodeum weakly declivous and medially with a superficial incision prolonging to the anterior part of the declivous face. Sides between the basal and declivous faces of the propodeum subangulate. Declivous face of propodeum flat. Metanotum with a median, broad, spiniform tooth. Lower part of the propodeal lobes obtuse and upper part round and partially lamelliform. Propodeal spiracles small.

Petiole in side view with declivous anterior face, the node more convex and less scale-like than in *silaceum*,. Anterior border of the petiole laterally

weakly marginate. Subpetiolar process small, triangular. Postpetiole anteriorly broader than the petiole; postpetiolar sides convex. Anterior border of the postpetiolar sternite with a superficial triangular "lip". Gastral tergite I convex in side view. Gastral sternite I large. Remaining gastral tergites and sternites weakly curved ventrally.

Legs as in the worker but more elongate. Hind basitarsi slightly shorter than hind tibiae.

Fore wings of our type 4, hind wings of our type 3 as defined in the description of the genus.

Genitalia as in Fig. 167.

Sculpture. Head and mesosoma minutely and superficially reticulate-punctate and with short, irregular rugosities, the rugosities sometimes absent on the anterior half but marked and longitudinal on the posterior half of the mesonotum, the reticulation broader on the basal face of the propodeum. Petiole, postpetiole and gaster smooth and with minute piligerous punctures. Legs smooth and minutely punctate.

Pilosity as in the worker but with the hairs of type (1) less dense.

Colour. Black with slightly lighter legs, antennae and mandibles.

Measurements in mm and Indices: TL 2.67-2.97; HL 0.50-0.55; HW 0.51-0.56; EL 0.24-0.28; SL 0.25-0.27; WL 0.86-1.00; PeL 0.19-0.20; PeW 0.22-0.25; HFeL 0.50-.057; HTiL 0.39-0.44; HBaL 0.35-0.40; LS4 0.35-0.41; LT4 0.60-0.70; CI 101.8-105.9; SI 48.1-51.0; IGR 0.57-0.59.

MATERIAL EXAMINED: UNITED STATES: NEW YORK: Staten Island, 13.V.1906, 1 worker, Wm. T. Davis [LACM]; Forest Park, Queens Co., 5.II.1978, 1 worker, 1 gyne, S. P. Cover [MCZC]. MASSACHUSETTS: Forest Hill, 22.V & 2.VI.1915, 2 workers, F. X. Williams [USNM]; Myles Standish State Forest, Plymouth Co., 1.6 mi W Long Pond Rd, park entrance, 6.II.1994, 1 worker, 1 gyne, S. P. Cover [MCZC]. PENNSYLVANIA: no further locality, 7 workers, Schmitt [MHNW]; no further locality, 1 male [NHMW]; Beatty, 1 worker, [USNM]; same locality, 1 worker, Schmitt [USNM]; St. Vincent, 2 workers, 1 gyne, 1 male [USNM]; Philadelphia, 20.V.1939, 5 workers, 1 gyne, W. L. Brown [USNM]. NEW JERSEY: Princeton, 31.III.1940, 6 workers, K. W. Cooper [LACM, USNM]. MARYLAND: near Plummers Island, 20.III.1921, 5 workers, 1 gyne, W. M. Mann [NHMB, USNM]; near Plummers Island, 21.IV.1923, 1 worker, H. S. Barber [USNM];

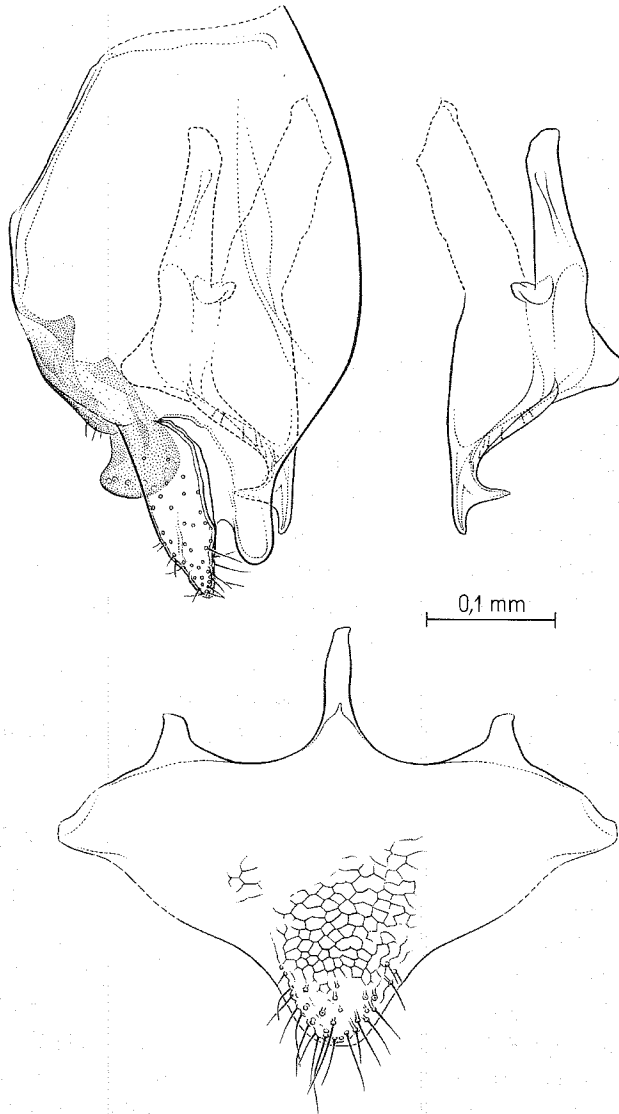


Fig. 167 – *Proceratium crassicorne* Emery. Male from Fairfax Co., near Annandale, Virginia, USA. Genital appendages: a) lateral view of left parameres and of their relative positions; b) right aedeagus in profile; c) subgenital plate in ventral view.

Takoma Park, 14.VI.1948, 1 gyne, F. Bonet [MZSP]; Pr. Georges Co., Bowie, 26.V.1968, field no. 1968-70, 2 workers, R. R. Snelling [LACM]; Chesapeake Bay, Center for Environmental Studies, Anne Arundel Co., 5.VIII.1975, 1 worker, B. Tremper & J. Lynch [LACM]. WASHINGTON D. C., 1 worker [MHNG]; same locality, May 21, 1 worker [USNM]; same locality, June 4, 1 worker [USNM]; same locality, 4.VII.1891, 1 worker (labelled as cotype no. 53577) [USNM]; same locality, 20.VII.1946, 1 worker, W. F. Buren [LACM]; same locality, 29.V.1895, 1 worker [USNM]; same locality, shore Potomac River, 5.V.1934, 1 gyne, H. S. Barber [USNM]; Corcoran Hill DC, 26.VII.1891, 2 workers (syntypes) [MCSN]; same locality and date, probably belonging to the type series, 2 workers [MCZC], 7 workers (erroneously labelled as cotypes no. 53577) [USNM]. MISSOURI: Barry Co., Ozark Mts., 8.7 mi S Junction RT 76/86 on Rt 112 at FSR 1037, 18.V.1996, elevation near 1000', 12 workers, 1 gyne, S. P. Cover [MCZC]. KENTUCKY: Laurel Co., Bald Rock, 23.III.1997, 1 worker, 1 gyne, M. & S. Deyrup [ABSC]. VIRGINIA: Chain Bridge, 6 workers, W. M. Mann [LACM, USNM]; Rosslyn, 29.IV.1920, 1 worker, W. M. Mann [USNM]; Occoquan, April, 2 workers, 1 gyne, W. M. Mann [USNM]; Black Pond, one pin with 2 upper workers = *crassicornis* and 1 lower worker = *silaceum* [USNM]; same locality, 1 gyne [USNM]; Dinwiddie Co., 14.VIII.1993, 1 worker, 1 gyne, 1 male, K. Hedlung [MCZC]; Fairfax Co., near Annandale, 6.IX.1982, 1 male, D. R. Smith [USNM]; same locality, 2, 18 & 25.VIII & 1.IX.1985, 6 males, D. R. Smith [LACM, USNM]; Caroline Co., Ruther Glen, 13.VIII.1996, 4 workers, 1 male, M. Deyrup [ABSC]. TENNESSEE: Smoky Mountains, 4 workers, 4 gynes, 4 males, A. C. Cole [LACM]; Smoky Mountains Natural Park, 10.VI.1947, 3 workers, 1 gyne, A. C. Cole [USNM]; Smoky Mountains Natural Park, Ramsey Cascade Tr., 5.VII.1999, 2 workers, M. Deyrup & S. Cover [ABSC]; Smoky Mountains Natural park, Cosby, 3.VII.1999, 1 worker, M. Deyrup & S. Cover [ABSC]; Smoky Mountains, Greenbrier Cove, 8.IV.1938, 47 workers, 1 gyne, A. C. Cole [LACM]; Smoky Mountains Natural Park, Greenbrier Cove, 5.VII.1999, 1 gyne, M. Deyrup & S. Cover [ABSC]; Tellico River above Boar Pens, Monroe Co., 24.V.1947, 7 workers, A. C. Cole [MZSP, USNM]; Chilhowee Mt., Servier Co., 21.X.1950, 12 workers, 1 gyne, A. C. Cole [LACM]; same locality, 5 & 16.V.1951, 9 workers, 3 gynes, A. C. Cole [LACM]. MISSISSIPPI: Louisville, 1 worker, M. R. Smith [USNM].

DISCUSSION. Wesson & Wesson (1940) between 1934 and 1939 within 45 miles from Jackson (Ohio) collected *crassicorne* four times in dry soil, in open woods under stones or moss. These authors collected a colony of *crassicorne* comprising 30 workers, a dealate female, about 8 males, 2 cocoons, 5 naked pupae and a few small larvae from the soft portion of a rotten log.

We considered *crassicorne* as a valid species and not a synonym of *silaceum* as proposed by Creighton (1950) since the characters listed in the diagnosis to separate the two species are consistent within all the material that we studied. The study of the male genitals of both species reveals small but significant differences between *crassicorne* and *silaceum*, i.e. the shape of the stipes and of the subgenital plate. Since, as already noted by Emery (1895), the two coexist in narrow sympatry, there seems to be no other alternative to consider them as valid, separate species. In the present paper we report additional records of both species from the same locality (e. g. in Tennessee).

DISTRIBUTION: United States: New York, Massachusetts, Pennsylvania, New Jersey, Maryland, Washington, Missouri, Kentucky, Virginia, Tennessee, Mississippi.

### **Proceratium mancum** Mann

Figs. 168, 169

*Proceratium mancum* Mann, 1922: 6. Worker [not gyne]. Original description. Type locality: Honduras (Cecilia). Type material: two workers labelled: Cecilia, Honduras, W. M. Mann collector, Cotype no. 24435, U.S.N.M., *Proceratium mancus* [sic] Mann, types; in USNM. Note: Mann (1922) described *mancum* on a worker and a gyne. The two specimens labelled as cotypes in USNM, however, are both workers, though one is larger than the other.

*Proceratium silaceum* Roger, Brown, 1974: 82. Partim. Nec Roger, 1863. Misidentification.

DIAGNOSIS. A *Proceratium* species belonging to the *silaceum* clade and resembling *silaceum* but differing from it, in the worker and gyne, by the posterior half of the head dorsum less sculptured, by the hairs of type (2)

longer and denser over the whole body and by the legs also with longer hairs (worker: mid basitarsi with hairs at least  $2/3$  of its length instead of at most  $1/2$  of its length; gyne: mid basitarsi with hairs at least  $1/3$  of its length instead of shorter than  $1/3$  of its length).

DESCRIPTION. *Worker* (Fig. 168) Head slightly longer than broad with the sides gently diverging posteriorly. Vertex in full face view gently convex. Clypeus reduced and as long as the antennal sockets. Anterior border of the clypeus truncate. Frontal carinae far from each other, broader than in *silaceum* and *crassicorne*. Lateral expansions of the frontal carinae broader than in *silaceum* and *crassicorne*, little raised, diverging on the two anterior fourths, converging on the third fourth, gently diverging and carinate only on the last fourth. Frontal area gently concave and with a median, longitudinal carina starting on the last fourth and prolonging backwards. Head anterolaterally with a variably marked longitudinal carina. Genal carinae marked, each carina corresponding to the external border of a deep sulcus. Eyes visible as a dark dot below the integument, small and on the middle of the head sides. First funicular joint about as long as broad. Funicular joints 2-10 broader than long. Last funicular joint about as long as the sum of joints 6-10. Scapes short of the vertexal margin and gently thickening apically. Masticatory margin of the mandibles with 7-9 denticles before the pointed apical tooth. Palp formula 2,2.

Mesosoma in side view weakly convex on the two anterior thirds, gently sloping on the posterior third. Pronotal and propodeal sutures absent. Basal face of the propodeum declivous posteriorly. Area between basal and declivous faces of the propodeum gently concave and laterally with a tooth. Declivous face of the propodeum weakly sloping posteriorly. Sides of the declivous face of the propodeum carinate. Propodeal spiracle round and above mid height in lateral view.

Petiole subrectangular, thick. Anterior border of the petiole straight and anterolaterally narrowly carinate. Ventral process of the petiole as in *silaceum* and *crassicorne* but slightly thicker. Postpetiole in dorsal view with the sides diverging posteriorly. Postpetiolar sternite anteromedially with a marked subtriangular projection, gently convex posteriorly in side view. Constriction between postpetiole and gaster impressed. Gastral tergite I about  $1/3$  longer than the postpetiole and convex on the curvature. Remaining gastral tergites and sternites curved ventrally.

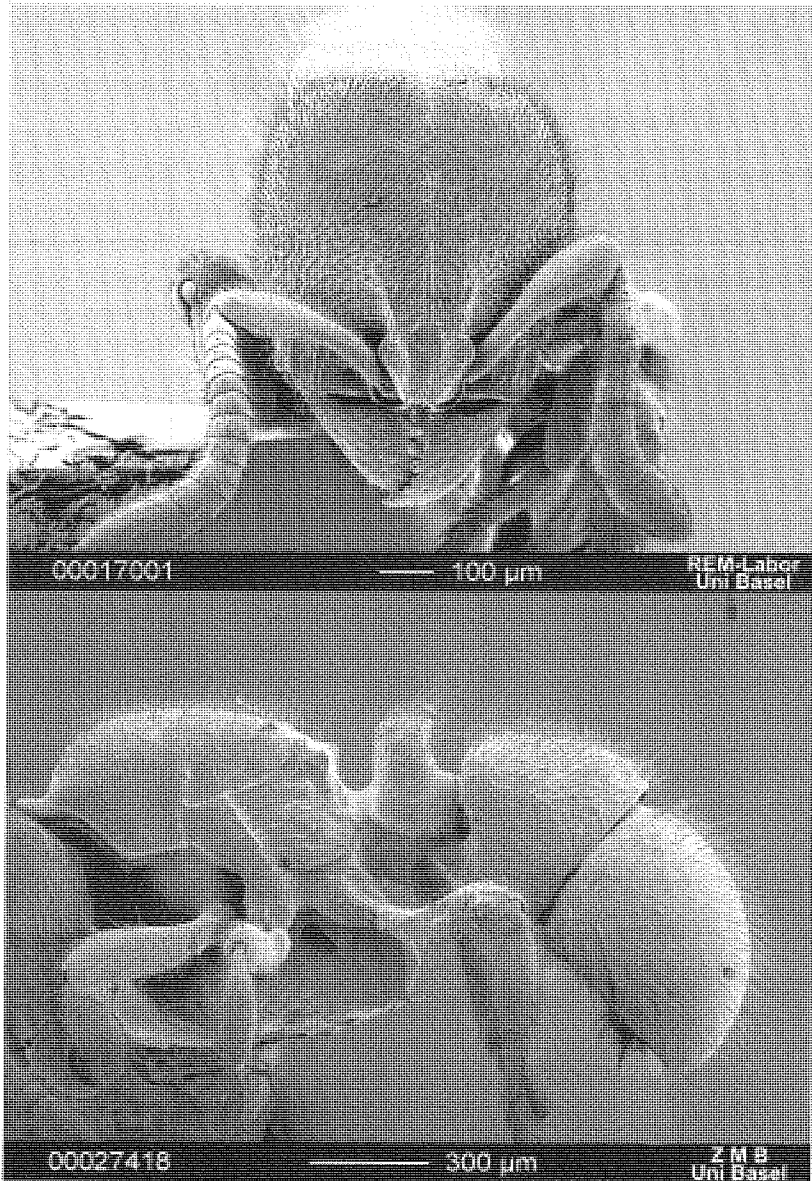


Fig. 168 – *Proceratium mancum* Mann. Worker from Biological Station La Selva, Heredia, Costa Rica: head (top) in dorsal view and meso- and metasoma (bottom) in side view.



Legs slightly elongate. All tibiae with a pectinate spur. Spurs of fore legs without basal spine. Fore basitarsi longer than the mid ones. Hind basitarsi about 1/5 shorter than hind tibiae. Second tarsomere of hind legs shorter than pretarsus. Pretarsal claws simple. Arolia absent.

Sculpture. Head, mesosoma, petiole and postpetiole punctate, reticulogrose, the reticulation and the rugosities larger on the anterolateral parts of the head, very superficial or absent on the posterior part of the head dorsum and on the anterior half of the mesosoma, the rugosities rare to sparse on the petiole and postpetiole, the punctures denser and mixed with granulation on the mesosoma, petiole and postpetiole. First gastral tergite smooth and with minute piligerous punctures, the punctures denser on the sides. Legs punctate.

Pilosity as in *silaceum* but with hairs of type (2) much longer and slightly denser.

Colour. Dark ferrugineous-brown with slightly lighter antennae and legs.

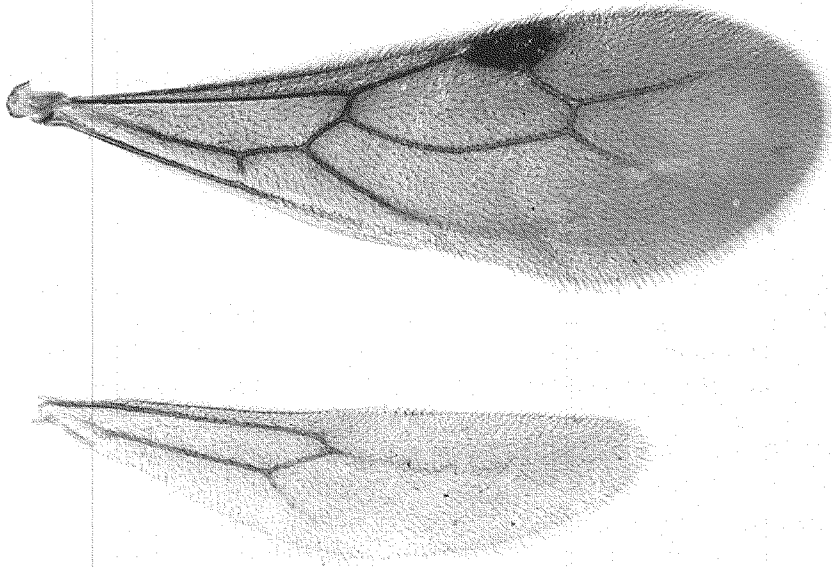


Fig. 169 – *Proceratium mancum* Mann. Gyne from Río Bravo, Belize: fore and hind wings.

Measurements in mm and Indices: TL 2.62-3.02; HL 0.59-0.66; HW 0.57-0.64; EL 0.02-0.03; SL 0.37-0.42; WL 0.73-0.86; PeL 0.20-0.22; PeW 0.27-0.31; HFeL 0.39-0.48; HTiL 0.35-0.39; HBaL 0.24-0.28; LS4 0.30-0.35; LT4 0.56-0.63; CI 96.6-97.0; SI 62.3-63.6; IGR 0.52-0.55.

*Gyne*. Differing from the worker in the following details: eyes large, slightly less than 1/3 of the head length, composed by many facets and with ocular pilosity. Ocelli well developed.

Mesosoma robust and gently convex in side view. Parapsidal furrows marked. Scutellum with the sides gently convex and with the posterior border subtruncate. Scutellum with a longitudinal carina, the carina sometimes prolonging only to the posterior half of the mesonotum and more superficial. Metanotum with a small tooth. Basal face of the propodeum almost flat laterally, concave medially, the concavity including the anteromedian part of the declivous face. Propodeal concavity dorsally variably carinate

Fore wings of our type 4, hind wings of our type 3 as defined in the description of the genus (Fig. 169).

Colour. As in the worker but with a dark brown macula in the position of the ocelli.

Measurements in mm and Indices: TL 3.58-4.27; HL 0.70-0.86; HW 0.70-0.86; EL 0.21-0.26; SL 0.44-0.56; WL 1.07-1.28; PeL 0.26-0.30; PeW 0.37-0.43; HFeL 0.57-0.72; HTiL 0.45-0.58; HBaL 0.35-0.48; LS4 0.43-0.61; LT4 0.79-1.08; CI 98.6-100.0; SI 61.6-65.1; IGR 0.54-0.56.

MATERIAL EXAMINED: MEXICO: SAN LUIS POTOSÍ: 11 km SE Tamazunchale, 8.VI.1988, 300 m, 1 worker, W. P. Mackay [WEMC]. NAYARIT: 31 mi S of Acaponeta, 24.XI.1948, 1 gyne, H. B. Leech [CASC]. VERACRUZ: Santa Lucrecia (= Jesús Carranza), IV.1923, 1 worker, 1 gyne, W. M. Mann [USNM]; Cordoba, Paraje Nueve, Nacimiento, 7.VIII.1969, trop. evergreen forest, 2 workers, S. & J. Peck [MCZC, MZSP]. GUERRERO: 4.III.1946, 1 gyne, with orchid plants (Lar-38666 46-2947) [USNM]. CHIAPAS: 6.6 mi W El Bosque, 4800 ft, 25.29.VIII.1973, 1 worker, A. Newton [MCZC]. BELIZE: Orange, Rio Bravo, 3-10.IX.1995, flight intercept trap, 1 gyne, P. Kovarik & J. Shuey [MCZC]. HONDURAS: Lancetilla near Tela, 19-21.III.1979, wet lowland forest, 2 workers, W. L. Brown [MCZC]; Cecilia, 2 workers (cotypes), W. M. Mann [USNM]. COSTA RICA: Province Heredia, Est. Biol. La Selva, 50-150 m, 2.III.1993, bosque primario, 1 worker, INBio-OET [INBC]; 16 km SSE La Virgen, 1050-1150 m, 10°16' N

84°05' W, 21.IV.2001, 1 gyne, INBio-OET-ALAS transect [INBC]. COLOMBIA: Ant. Providencia, Estacion Biol., Zona Buenos Aires, 600-800 m, 30-31.XII.1977, 1 gyne, C. Kluger [MCZC].

DISCUSSION. The *silaceum* clade is represented by 4 species in the New World. *P. mancum* is the sole New World species of the *silaceum* clade occurring in the Neotropics. The other three species, *croceum*, *silaceum* and *crassicorne* are apparently confined to the Nearctic region. *P. mancum* can be easily distinguished from *croceum*, *silaceum* and *crassicorne* by the presence of longer body hairs of type (2). This trait is especially visible on the mid and hind basitarsi where they reach at least half of the basitarsal length.

Brown (1958a) reports the presence of *mancum* in Guatemala. We did not examine any material of this species from Guatemala but have no reason to doubt this record.

DISTRIBUTION: Mexico, Belize, Guatemala, Honduras, Costa Rica and Colombia.

### ***Proceratium lumbokense* Emery**

*Proceratium lumbokense* Emery, 1897: 593. Gyne. Original description. Type locality: Lombok Island, Indonesia. Type material: holotype gyne labelled: "Lombok, Sapit 2000", April 1896, H. Fruhstorfer, Typus, *Proceratium lumbokense*, n. sp. Emery", in MCSN, examined.

DIAGNOSIS. A *Proceratium* species belonging to the *silaceum* clade, and differing from the other Oriental species, in the gyne, by the following combination of characters: TL = 4.90 mm (instead < 4.50 mm), frontal carinae very broad and petiole subrectangular.

DESCRIPTION. *Gyne*. Head slightly broader than long, with subparallel sides. Anterior clypeal border weakly concave and about as long as the antennal sockets. Frontal carinae far from each other and with broad lateral expansions. Lateral expansions of the frontal carinae diverging on the two

anterior fourths, converging in the third fourth, subparallel and carinate only on the last fourth., Genal carina short, weakly impressed and corresponding to the external border of a deep, longitudinal sulcus. Eyes large, on the midline of the head and with hairs. Ocelli well developed. First funicular joint about as long as broad. Funicular joints 2-10 broader than long. Last funicular joint about as long as the sum of joints 7-10. Scapes reaching the anterior ocellus; proximal half of the scape about half narrower than the distal half. Mandibles subtriangular. Masticatory margin of the mandibles with 10 denticles followed by a relatively large, subapical tooth and a pointed apical tooth. Palp formula not well visible but probably 2,2.

Mesosoma robust. Mesonotum gently convex. Parapsidal furrows superficially impressed. Scutellum almost flat, about 1/3 broader than long. Metanotum with a small, flat, pointed spine. Propodeum with distinct basal and declivous faces laterally separated by a small, pointed denticle. Basal face of the propodeum shorter than the declivous face and dorso-medially declivous posteriorly. Propodeal lobes subround. Propodeal spiracle round and above mid height in lateral view.

Petiole about 1/3 broader than long. Petiolar node narrow in side view, with gently convex dorsum and slightly higher than the anterior part of the postpetiole. Anterior border of the petiole straight and anterolaterally carinate. Ventral process of the petiole broad, lamelliform, convex anteriorly and with a small spine gently pointing backwards. Postpetiole slightly longer than 1/2 of gastral tergite I. Postpetiolar sides diverging backwards. Postpetiolar sternite anteromedially with a marked subrectangular projection. Constriction between postpetiole and gastral segment I impressed. Gastral tergite I convex. Remaining gastral tergites and sternites curved ventrally.

Legs slender, not very elongate. All tibiae with a pectinate spur. Spurs of fore legs without basal spine. Fore basitarsi longer than the mid ones. Hind basitarsi slightly shorter than hind tibiae. Pretarsal claws simple. Arolia absent.

Wings missing.

Sculpture. Body superficially shining and variably punctate. Head more opaque than the rest of the body and with additional, thin, irregular rugosities. Metapleurae longitudinally rugulose, the rugosities slightly thicker

than on the head. Basal face and part of the declivous face of the propodeum with additional transversal, thin, rugosities. Petiole and postpetiole with superimposed small granulation.

Body covered by hairs of three types: (1) short, dense, subdecumbent on the head, on the mesosoma, on the petiole, on the postpetiole and on the gaster, decumbent on the scapes and on the legs, suberect and sparse on the funicular joints; (2) longer, thicker and sparser than hair type (1), erect or suberect on the whole body; (3) shorter than hairs of type (1), dense, decumbent and appressed on the funicular joints only. In addition the scapes bear sparse hairs, shorter than type (2), the funicular joints bear thick, appressed, short, sparse hairs.

Colour orange to light brown.

Measurements in mm and Indices: TL 4.90; HL 0.98; HW 1.02; EL 0.27; SL 0.65; WL 1.44; PeL 0.33; PeW 0.48; HFeL 0.87; HTiL 0.64; HBaL 0.58; LS4 0.60; LT4 1.14; CI 105.0; SI 66.3; IGR 0.53.

MATERIAL EXAMINED: INDONESIA: LOMBOK ISLAND: Sapid, 2000', IV.1896, 1 gyne (holotype), H. Fruhstorfer [MCSN].

DISCUSSION. This unique gyne of *lombokense* appears to be the second largest species of the *silaceum* clade in the Old World. Only *relictum* from the Fiji Islands is larger than *lombokense*. *Relictum* differs from *lombokense* mainly by the shape of the petiole which is flattened apically. The gyne of *sulawense* (TL 4.32-4.34 mm) is the third largest species of the *silaceum* clade of the Old World. *Sulawense* shares with *lombokense* the broad frontal carinae, the petiole subrectangular and a large value of CI ( $\geq 104$ ). *Lombokense* differs from *sulawense* mainly by the sculpture, much more superficial, and by the light colour, orange light brown instead of dark ferruginous-brown.

DISTRIBUTION: Indonesia (Lombok Island).

## SPECIES INQUIRENDA

**Proceratium longigaster** Karavaiev

*Proceratium longigaster* Karavaiev, 1935: 59, fig. 2. Worker. Original description. Type locality: Bana (Tourane) Vietnam. Type material not available for the present study.

DISCUSSION. The drawings by Karavaiev (1935) show an anteriorly straight clypeus and a rectangular petiole, two traits typical of the *silaceum* clade. If, on one hand, this leaves no doubts about the belonging of *P. longigaster* to this clade, further precision on its specific relationships will be possible only after examination of the specimen in question.

DISTRIBUTION: Vietnam.

## CONCLUDING REMARKS

In the following we shall attempt to test some broader evolutionary hypotheses within *Proceratium* and to reconstruct the most parsimonious evolutionary path for some significant characters with the help of the completely resolved phylogeny of Fig. 31.

One of the most characteristic morphological traits of *Proceratium*, i. e. the gaster curved forwards, is common to the other Proceratiini genera as well. Poldi (1964) offers some experimental evidence to explain the function of this structure in *P. melinum*. According to Poldi (l. c.) the curved gaster is used in a form of reversed phragmosis to block the nest galleries against intruders. In spite of the limited number of case studies, the fact (always reported by Poldi, l. c.) that this behaviour is not performed in absence of other ant species may be considered as a control observation.

Brown (1980) reports that in *P. silaceum* the reflexed gaster is used to manipulate prey eggs.

Poldi's and Brown's explanations are not mutually exclusive but the one of Poldi accounts for a probably more substantial function.

The degree of curvature of the gaster is often considered as a taxonomic character in *Proceratium* and it is measured as the "Index of Gastral Reflexion" (IGR, see the definition in the Methods chapter). We also used it for both the species descriptions and for the cladistic analysis. High IGR values indicate a small reflexion of the gaster and low IGR values represent very curved gasters. The IGR, however, exhibits a noteworthy degree of variation. For our phylogenetic reconstruction we were compelled to treat it as a two-steps character, i. e.  $IGR \leq 0.29$  or  $\geq 0.31$ . Even so, a few species like *P. compitale*, *pergandei* and *avioide* escape this rough simplification and emerge as polymorphic with individuals beyond the maximum or the minimum fixed for the two categories. Since the other two Proceratiini genera may have low or variable IGR values (*Discothyrea*) or high (*Bradoponera*), it may be interesting to trace the most parsimonious reconstruction of this trait within *Proceratium* (Fig. 170). We are aware of the risk potentially implied in our procedure, i. e. drawing a phylogeny based on the IGR and testing the evolutionary path of the IGR on the same phylogeny. The IGR, of course, is only one of the 62 characters on which our phylogeny is based and it has a Rescaled Consistency Index of 0.52 with the phylogeny.

Figure 170 shows that, within *Proceratium*, the character evolves in six

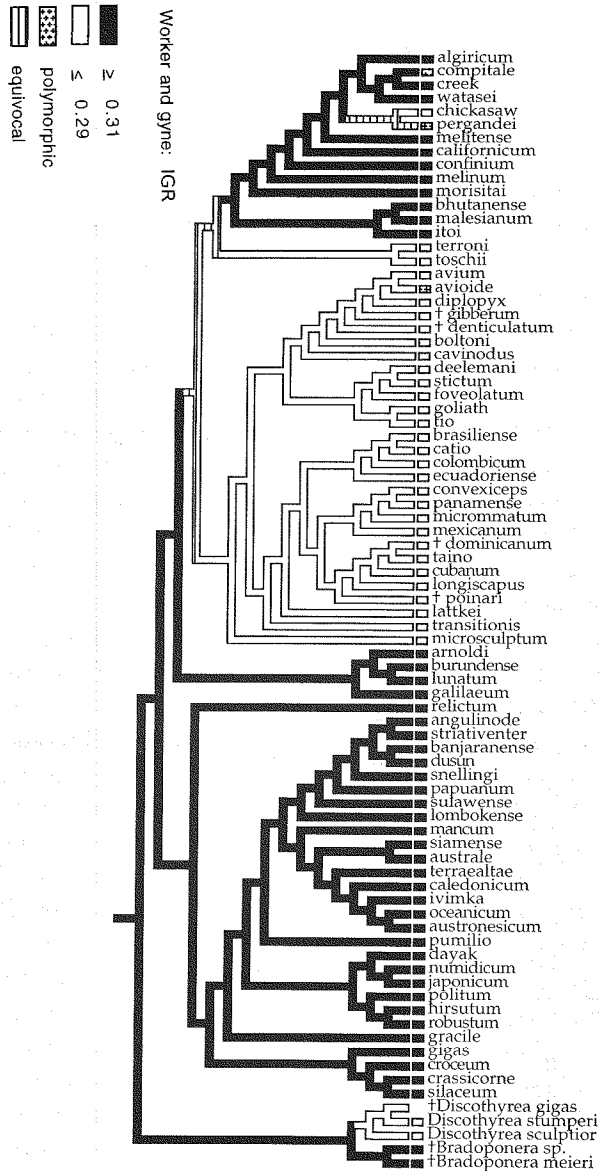


Fig. 170 – Most parsimonious reconstruction of the evolution of the gastral curvature (IGR) in *Proceratiini* mapped on the phylogeny of Fig. 31. The branches traced as equivoical are unresolved to account for all possible most parsimonious states.



steps, i. e. from an ancestor with moderately curved gaster, the curvature increased in the common ancestor of the clades *stictum* (with a secondary partial reduction in *avioide*), *micrommatum* and *microsculptum*, and possibly independently in the ancestor of the *toschii* clade and for the species *pergandei* and *compitale* (both polymorphic). Assuming that the curvature of the gaster evolves according to an irreversible model (i. e. from an ancestral *Proceratium* with less curved gaster only growths of the curvature may have occurred) increases the number of evolutionary steps from 6 to 14.

Curiously enough, this ancestral reduction of the IGR with subsequent increase appears to fit much more the optimal reconstruction of the evolution of the male gaster morphology. An unordered increase of the male IGR costs only two evolutionary steps and the irreversibility hypothesis only three. Since it is unlikely that males either exercise the phragmotic behaviour or carry eggs they should be selection-free. On the other hand one may also suppose that a curved male gaster will facilitate mating with curved gaster gynes. We do not attribute too much importance to this result inasmuch as only the males of 20 *Proceratium* species are known, 12 with low IGR and 8 with a high one.

It seems that if the curved gaster is an advantage in blocking the nest galleries against intruders, there is no great benefit in having it much more curved; this advantage appears to have been partly lost at least twice, in *P. pergandei* and *avioide*.

Another interesting fact about *Proceratium* is its distribution. The genus is broadly pantropical with deep penetrations into temperate and cold areas like the Czech Republic and southern Canada. The fact was already noted by Arnoldi (1930) who interprets the present distribution as relict of a broader area occupied by the genus during Miocene or Oligocene. If, on one hand, the Oligocene Baltic *Bradoponera* and the Miocene records of *Proceratium* described in the present paper leave little doubt on a minimum Tertiary age for the genus, its presence in all biogeographic regions of the world except the Antarctic is better explained by dispersal.

The remarkable amount of dispersal undergone by *Proceratium* species emerges in a dramatic way while taking into account our phylogenetic inferences. Out of eight clades we recognised, only three (the *micrommatum* clade, the monotypic *microsculptum* and the *toschii* clade containing two species only) are distributed in only one biogeographic region. Three clades

(*pergandei*, *itoi* and *arnoldi*) occupy two different biogeographic regions. The *stictum* clade occupies four biogeographic regions and the *silaceum* clade is distributed over five biogeographic regions. To account for this cosmopolitanism coupled with morphological uniformity one must suppose several dispersal events following the origin of the genus.

In an attempt to trace back the most probable geographic origin of *Proceratium* we coded the known distribution of all its species as presence or absence in a given biogeographic region and we quantified a plain biogeographic hypothesis.

Our hypothesis was simply that dispersal between two regions contiguous or close implies one evolutionary step and dispersal between two distant regions has a double cost, i. e. it implies two evolutionary steps.

This hypothesis was translated in the stepmatrix of Tab. III and implemented in McClade 3.1 (Maddison & Maddison, 1992).

Tab. III - Stepmatrix expressing the number of evolutionary steps accounting for dispersal between all pairs of biogeographic regions inhabited by *Proceratium*. Further explanations in text.

	Palaearctic	Neartic	Afrotropical	Oriental	Oceanian	Australian	Neotropical
Palaearctic	0	1	1	1	2	2	2
Neartic	1	0	2	2	2	2	1
Afrotropical	1	2	0	1	2	2	1
Oriental	1	2	1	0	1	1	2
Oceanian	2	2	2	1	0	1	2
Australian	2	2	2	1	1	0	2
Neotropical	2	1	1	2	2	2	0

Mapping the most parsimonious reconstruction of dispersal as hypothesised in Tab. III on our phylogeny of Fig. 31 gives a number of unequivocal reconstructions of the ancestral distribution of the genus (Fig. 171).

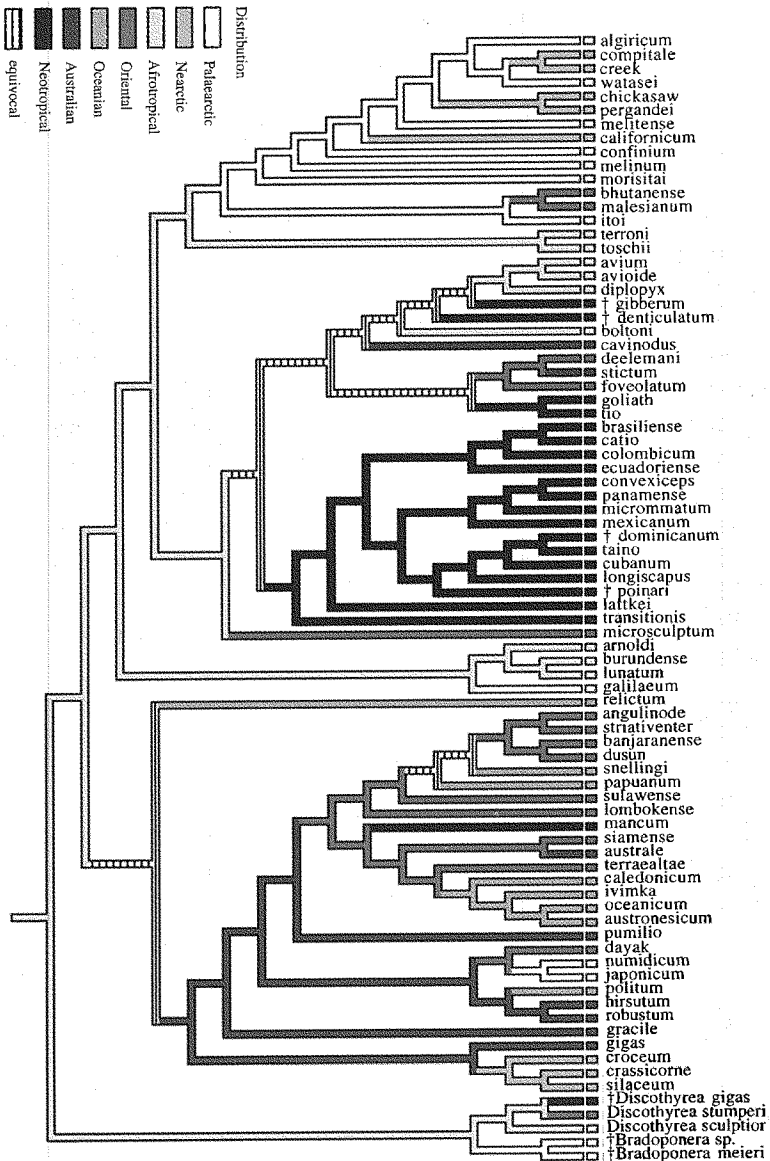


Fig. 171 – Most parsimonious reconstruction of the ancestral distribution of *Proceratium* inferred from the dispersal model of Tab. III mapped on the the phylogeny of Fig. 31. Further explanations in text.

One might object to the fact that, for our reconstruction, we mix Recent and Miocene species. It is obvious that we ignore since how long a species occupies a biogeographic region. But, given the morphological uniformity of the fossil and of the extant species, it seems safe to assume that, in *Proceratium*, things go slowly enough as to permit the comparison.

Assuming that our dispersal hypothesis is correct, *Proceratium* should have an Afrotropical origin, a rather surprising deduction if one considers the relatively low number of species presently known from the Afrotropical region (9). From this Afrotropical source a purely Afrotropical branch evolved into the *arnoldi* clade with one species colonising the Palaearctic. Two more Afrotropical sources gave rise to the *stictum* clade (Afrotropical, Australian and Dominican fossil), to the *micrommatum* clade (Neotropical) and to the monotypic *microsculptum* clade (Oriental). Another Afrotropical branch remained in part on the African continent with the *toschii* clade while another, Palaearctic branch gave origin to the *ittoi* clade (Palaearctic and Oriental) and to the *pergandei* clade (Palaearctic and Nearctic). All these branches of Afrotropical origin had an early sister-group of equivocal distribution from which originate the highly dispersed *silaceum* clade: its members are reported from all the biogeographic regions except the Afrotropical.

Finally, we should warn about indiscriminate use of all the ancestral reconstructions of Fig. 171. The figure displays an Afrotropical origin for the tribe Proceratiini as well. Supposing that our dispersal hypothesis, its quantification in the stepmatrix and the phylogenetic reconstruction we used as working tool are correct, this result could be still drastically modified by extending the analysis to other taxa including the sister group of the Proceratiini.

## IDENTIFICATION KEYS

In the following we present keys to the identification of the species. Given the high number of species for which the gyne and the male are still unknown we have limited our keys to the worker caste.

As it is usually done we present separate keys for the species belonging to different biogeographic regions. Only the nearctic and neotropical species are treated together since this poses no particular problems and it might simplify the identification of material originating from the boundary zones.

Preparing different keys for different regions facilitates both the compilation and the use of the key. It has, however, the drawback that species newly collected in a region or new species with affinities in other regions become hard to identify. For this reason, at the end, we present also a key for the whole genus *Proceratium*. This was harder to prepare; it will be also harder but safer to use.

### Key to the *Proceratium* workers from the Palaearctic Region

1. Lower mesopleura entirely inflated. Petiole and postpetiole with a posterodorsal transparent blister under the integument. Israel.....*galilaeum*  
- Lower mesopleura not inflated. Petiole and postpetiole without a posterodorsal transparent blister under the integument .....(2)
  
2. Petiole without neck and rectangular. Anterior clypeal border straight. First gastral tergite with a transparent macula close to the posterior border. Palp formula 2,2 .....(3)  
- Petiole convex. Anterior clypeal border medially rectangular or triangular. First gastral tergite without transparent macula. Palp formula 4,3, 3,3 or 3,2 .....(4)
  
3. Postpetiole very sparsely granulopunctate. TL 3.03-3.29 mm and petiolar width 0.27-0.29 mm. Tunisia, Algeria, Cyprus, Turkey and Albania .....  
.....*numidicum*

- Postpetiole strongly granulopunctate TL 2.84-3.32 mm and petiolar width 0.30-0.35 mm. Japan, Taiwan .....*japonicum*
- 4. Propodeal suture well marked. First funicular joint about 1/2 longer than broad. Pakistan .....*confinium*
- Propodeal suture absent. First funicular joint at most 1/3 longer than broad .....(5)
- 5. Clypeus medially strongly protruding anteriorly and rectangular .....(6)
- Clypeus medially protruding anteriorly but triangular.....(8)
- 6. Propodeal lamellae absent. Head only weakly convex posteriorly. Integumental sculpture superficial. Malta and Sicily.....*melitense*
- Propodeal lamellae well developed. Head convex posteriorly. Integumental sculpture well marked .....(7)
- 7. Mesosoma, petiole and postpetiole with deep sculpture. Body dark ferruginous. Japan, Korea, Korea?, China? .....*watasei*
- Mesosoma, petiole and postpetiole with superficial sculpture. Colour light brown. Italy, Croatia, Greece, Algeria, Morocco and Tunisia.....*algericum*
- 8. Fore tibiae without basal spine. Second tarsomere of hind legs shorter than pretarsus. First gastral sternite protruding over the postpetiolar sternite. Japan, Korea?, China? .....*itoi*
- Fore tibiae with basal spine. Second tarsomere of hind legs at least as long as the pretarsus. First gastral sternite not protruding over the postpetiolar sternite .....(9)
- 9. Head granulate-punctate. Petiole slightly longer than broad. Second tarsomere of hind legs about as long as the pretarsus. Japan.....*morisitai*
- Head reticulate-punctate. Petiole about as broad as long. Second tarsomere of hind legs about 1/5 longer than the pretarsus. Czech Republic, Hungary, Ukraine, Yugoslavia, Italy, Romania, Bulgaria, Albania, Greece, Turkey, Spain.....*melinum*

### Key to the *Proceratium* workers from the Indomalayan Region

*P. lombokense*, known on the gyne only, and *P. longigaster*, unknown to us are omitted from this key.

1. Petiole with peduncle, convex or subconvex in profile. Anterior clypeal border strongly protruding anteriorly or at least medially triangular. Mandibular base without light macula. First gastral tergite without a clear macula visible in transparency posteriorly. Palp formula 3,2 or 4,3 .....(2)
  - Petiole without peduncle, rectangular in profile. Anterior clypeal border straight or weakly concave, never protruding anteriorly. Base of the mandibles with a light macula. Palp formula 2,2. First gastral tergite with a light macula visible in transparency posteriorly .....(6)
  
2. Sides of the propodeum with a developed spine. Propodeal lobes with a broad lamellaceous tooth only .....(3)
  - Sides of the propodeum at most with a small tip, without a true spine. Propodeal lobes without broad lamellaceous tooth, at most with a lamella over the whole declivous face .....(4)
  
3. First gastral tergite angulate on the curvature. Gaster entirely foveolate. Malaysia (Sarawak).....*foveolatum*
  - First gastral tergite round on the curvature. Gaster at most punctate. Borneo, Brunei, Malaysia (Sabah and Sarawak), Thailand and Singapore .....  
.....*deelemani*
  
4. Frontal carinae fused. Clypeus strongly protruding anteriorly. Mesosoma, petiole, postpetiole and gaster foveolate. Malaysia (Sabah) ...*microsculptum*
  - Frontal carinae not touching each other. Clypeus reduced to a triangular tooth between the antennal sockets. Mesosoma, petiole and postpetiole granulate, gaster punctate.....(5)
  
5. Body without long erect hairs. Propodeal sides at most with a narrow lamella. Hairs on mesobasitarsi shorter than 1/2 the mesobasitarsal length. Bhutan.....*bhutanense*
  - Body with long erect hairs. Propodeal sides with a broad lamella over their whole length. Mesobasitarsi with hairs 1/2 the mesobasitarsal length. Malaysia (Pahang) .....*malesianum*

6. Postpetiole in dorsal view concave and laterally lobate. Posterior border of first gastral tergite folded. Head, mesosoma, petiole, postpetiole and gaster strongly sculptured. First gastral tergite with traces of longitudinal rugosities .....(7)  
 - Postpetiole in dorsal view neither concave nor laterally lobate. Posterior border of the first gastral tergite not folded. Head, mesosoma, petiole, postpetiole and gaster less strongly sculptured. First gastral tergite without traces of longitudinal rugosities .....(8)
7. Frontal area at least 1/3 of the head width. Sides of the propodeum with a small denticle. Rugosities on the first gastral tergite more irregular and thin (Fig. 146). SI < 65. Malaysia (Sarawak).....*angulinode*  
 - Frontal area about 1/4 of the head width. Sides of the propodeum with a broad lamellaceous tooth. Rugosities on the first gastral tergite more regular and thicker (Fig. 147). SI > 74. Malaysia (Sarawak) .....*striativenter*
8. TL < 2.65 mm. HBaL ≤ 0.24 mm. Papua New Guinea, Philippines, Sumatra, Malaysia, Sabah and Solomon Islands .....*papuanum*  
 - TL ≥ 2.72 mm. HBaL > 0.27 mm .....(9)
9. Hairs on the mid basitarsi never longer than 1/2 of the basitarsal length .....(10)  
 - Hairs on the mid basitarsi 2/3 of the basitarsal length .....(12)
10. Mesosoma, petiole and postpetiole smooth or at most minutely punctate. SI > 69. Malaysia (Pahang) .....*terraealtae*  
 - Mesosoma, petiole and postpetiole densely granulopunctate. SI < 67 ..(11)
11. Frontal area narrow and frontal carinae short (Fig. 129). Colour dark ferruginous. Malaysia (Sarawak) .....*dayak*  
 - Frontal area broader and frontal carinae longer (Fig. 143). Colour yellowish to brown. Japan, Taiwan .....*japonicum*
12. Frontal area narrow, about 1/4 of the maximum HW. CI < 92. SI > 68. Colour light brown. Thailand .....*siamense*  
 - Frontal area broad, about 1/3 of the maximum HW. CI > 93. SI < 67. Colour ferruginous .....(13)



13. Hairs of hind basitarsi at most 1/2 of the basitarsal length. CI > 98. Malaysia (Sarawak) .....*sulawense*  
 - Hairs of hind basitarsi longer than 1/2 of the basitarsal length. CI < 97....(14)
14. IGR 0.44. First gastral tergite convex (Fig. 148). Malaysia (Sabah) .....  
 .....*banjaranense*  
 - IGR  $\geq$  0.48. First gastral tergite less convex (Fig. 149). Malaysia (Sabah)  
 .....*dusun*

### Key to the *Proceratium* workers from the Oceanian Region

1. Petiole triangular and clearly narrowing dorsally in profile (Figs. 126, 127) .....(2)  
 - Petiole rectangular, broad or narrow but never narrowing dorsally in profile (Figs. 131, 150) .....(3)
2. Lateral expansions of the frontal carinae broad and widely separated from each other. Head densely punctate (Fig. 126). SI > 76. TL > 4.5 mm. Fiji Islands .....*relictum*  
 - Lateral expansions of the frontal carinae narrow and closer to each other. Head sparsely punctate (Fig. 127). SI < 73. TL < 3.7 mm. Fiji Islands .....  
 .....*oceanicum*
3. TL  $\leq$  2.3 mm. Frontal carinae about 1/4 of the head width; .....(4)  
 - TL  $\geq$  2.37 mm; if the TL approaches 2.3 mm (in *papuanum* TL 2.37-2.59 mm), then the frontal carinae are 1/3 of the head width .....(5)
4. Head dorsum and mesosoma strongly reticulate. Mesosoma convex in profile. Colour dark reddish-brown. CI  $\geq$  100. Papua New Guinea..*snellingi*  
 - Head dorsum and mesosoma at most minutely punctate. Mesosoma elongate in profile. Colour black. CI < 96. Papua New Guinea.....*ivimka*
5. Frontal area very broad, at least 1/3 of the maximum head width .....(6)  
 - Frontal area at most 1/4 of the maximum head width .....(7)
6. TL < 2.65 mm. Mesosoma, petiole and postpetiole with traces of granulation. Papua New Guinea, Philippines, Sumatra, Malaysia, Sabah and Solomon Islands.....*papuanum*

- TL > 3.00 mm. Mesosoma, petiole and postpetiole at most minutely punctate. New Caledonia.....*politum*

7. Body smooth and at most with minute piligerous punctures. Petiolar width less than 1 and 1/2 of the petiolar length. Colour yellow-light brown, legs concolourous. New Caldedonia .....*caledonicum*

- Body superficially smooth and at least with punctations and small, sparse granulation. Petiolar width at least 1 and 1/2 of the petiolar length. Colour dark reddish brown or black with lighter legs. Papua New Guinea.....  
.....*austronesicum*

### Key to the *Proceratium* workers from the Afrotropical Region

1. Gastral tergite I greatly hypertrophied posteriorly (Fig. 35). Madagascar .....*diplopyx*

- Gastral tergite I round posteriorly.....(2)

2. Clypeus protruding anteriorly and surrounding the antennal sockets. Fore tibiae with a basal spine .....(3)

- Clypeus reduced, medially subconvex, not surrounding and at most as long as the antennal sockets. Fore tibiae without basal spine .....(5)

3. Propodeal sides at least with a well marked angle. Funicular joints broader than long. Head, mesosoma, petiole and postpetiole opaque. Ghana .....*boltoni*

- Propodeal sides unarmed, convex in side view. Funicular joints about as long as broad. Head, mesosoma, petiole and postpetiole at least superficially shining .....(4)

4. Integumental foveae smaller (Fig. 36). Pilosity denser and shorter. Gaster convex in side view. IGR 0.27-0.29. Mauritius.....*avium*

- Integumental foveae larger (Fig. 37). Pilosity sparser and longer. Gaster less convex in side view. IGR 0.31-0.34. Mauritius.....*avioide*

5. Frontal carinae very close to each other and posteriorly fused. Lower mesopleura flat. Integumental sculpture at most granulate.....(6)

- Frontal carinae far from each other and diverging posteriorly. Lower mesopleura posteriorly inflated. Integumental sculpture granulate-foveolate ....(7)
- 6. Head and mesosoma with suberect hairs. Kenya .....*toschii*
- Head and mesosoma without suberect hairs. Cameroon .....*terroni*
- 7. Integumental foveae superficial. First gastral tergite longer than 1/4 of the postpetiole. Zimbabwe .....*arnoldi*
- Integumental foveae deep. First gastral tergite 1/7 or less of the length of the postpetiole .....(8)
- 8. Integumental foveae smaller and more superficial. Gastral sculpture more superficial (Fig. 122). Burundi .....*burundense*
- Integumental foveae larger and more marked. Gastral sculpture deeper (Fig. 121). Cameroon .....*lunatum*

#### **Key to the *Proceratium* workers from the Australian Region**

- 1. Petiole convex in profile. Clypeus protruding anteriorly. Fore tibiae with a basal spine. Palp formula 4,3.....(2)
- Petiole subrectangular in profile. Clypeus straight. Fore tibiae without basal spine. Palp formula 2,2 .....(3)
- 2. Postpetiole medially concave and laterally gently lobate. Sculpture shallow. Standing hairs sparse and short. Australia (Northern Territory).....*cavinodus*
- Postpetiole medially straight and laterally convex. Sculpture deeper. Standing hairs longer and denser. Australia (Queensland).....*stictum*
- 3. Petiole more than 1 and 1/2 broader than long.  $TL \leq 2.63$  mm and  $PeW \leq 0.33$  mm. Australia (Queensland).....*pumilio*
- Petiole at most 1 and 1/2 broader than long. If  $TL \leq 2.63$  mm (a few workers of *australe*), then  $PeW \leq 0.27$  mm .....(4)
- 4. Body with long standing hairs (Fig. 135).  $SI > 73$ . Australia (Queensland) .....*hirsutum*
- Body with shorter standing hairs (Figs. 137 and 140).  $SI < 70$  .....(5)

5. Postpetiole shining or at most with sparse, minute piligerous punctures and few, very small, granulations.....(6)  
 - Postpetiole strongly and densely granolopunctate.....(7)
6. Long hairs sparse and suberect on the gaster. Mid basitarsi with hairs at most 1/3 their length. CI < 93. SI > 68. Australia (Queensland) .....*gracile*  
 - Long hairs denser, subdecumbent and decumbent on the gaster. Mid basitarsi with hairs about 1/2 their length. CI > 94. SI < 65. Australia (New South Wales) .....*robustum*
7. Mesosoma strongly convex in profile (Fig. 141). Propodeal sides with a tooth. CI < 85. TL = 3.72 mm. Australia (New South Wales).....*gigas*  
 - Mesosoma more elongate (Fig. 137). Propodeal sides at most denticulate. CI > 89. TL < 3.5 mm. Australia (Queensland, New South Wales)...*australe*

### **Key to the *Proceratium* workers from the Nearctic and Neotropical Regions**

The species †*denticulatum*, †*dominicanum*, †*gibberum*, and *longiscapus*, known on the gyne only, are excluded from this key.

1. Mid tibiae without pectinate spur.....(2)  
 - Mid tibiae with a pectinate spur .....(12)
2. Propodeal dorsum with a swelling covered by short hairs only (Figs. 59, 63, 65) .....(3)  
 - Propodeal dorsum without swelling and covered by short and long hairs (Figs. 74, 92, 168) .....(6)
3. Gaster entirely sculptured .....(4)  
 - Gaster sculptured only over the posterior half or less.....(5)
4. Head and mesosoma reticulate-foveolate and granulate. Propodeal swelling broad and low. Ecuador.....*ecuadoriense*  
 - Head and mesosoma granulate. Propodeal swelling narrow and high. Colombia .....*colombicum*

5. Petiole  $1/5$  longer than broad. Postpetiole shorter than  $1/2$  of the gastral tergite I. Postpetiole and gaster more convex. Colombia.....*catio*  
 - Petiole at most  $1/8$  longer than broad. Postpetiole slightly longer than  $1/2$  of the gastral tergite I. Postpetiole and gaster less convex. Brazil.....*brasiliense*
6. Mid basitarsi with hairs shorter than  $1/2$  of the basitarsal length .....(7)  
 - Mid basitarsi with at least one hair about  $1/2$  of the mid basitarsal length ..(8)
7. Postpetiole shorter than  $1/2$  of the length of the first gastral tergite. TL  $\geq$  3.70 mm. Dark ferruginous-brown. Dominican Republic .....*taino*  
 - Postpetiole about  $1/2$  of the length of the first gastral tergite. TL  $\leq$  3.00 mm. Light brown. Cuba .....*cubanum*
8. Area between the basal and declivous faces of the propodeum with a transverse carina angulate or denticulate laterally .....(9)  
 - Area between the basal and declivous faces of the propodeum with at most very superficial traces of transverse carina .....(10)
9. Postpetiole anterolaterally convex. IGR  $< 0.21$ . TL  $> 2.8$  mm. Mexico.....  
 .....*mexicanum*  
 - Postpetiole anterolaterally angulate. IGR  $> 0.23$ . TL  $< 2.5$  mm. Dominican amber .....†*poinari*
10. Mesosoma gently convex in profile. Postpetiole in dorsal view more convex and slightly angulate anterolaterally. Integumental sculpture impressed. Costa Rica, ?Mexico .....*convexiceps*  
 - Mesosoma more elongate in profile. Postpetiole in dorsal view more rectangular and angulate anterolaterally. Body sculpture more superficial ..(11)
11. TL  $\geq 3.80$  mm. WL  $\geq 1.05$  mm. Costa Rica, Panama.....*panamense*.  
 - TL  $< 3.60$  mm. WL  $\leq 0.95$  mm. Honduras, Costa Rica, Panama, Colombia, Venezuela. Texas?, Ecuador? .....*micrommatum*
12. Petiole rectangular. Anterior clypeal border unarmed, straight. Palp formula 2,2.....(13)  
 - Petiole convex. Anterior clypeal border subconvex, rectangular or triangular. Palp formula 3,2 or 4,3.....(16)

13. TL > 3.7 mm. Frontal area broader than 1/3 of the maximum HW. United States .....*croceum*  
 - TL < 3.5 mm. Frontal area at most slightly more than 1/4 of the maximum HW, or, if the frontal area is 1/3 of the maximum HW (*manicum*), then the mid and hind basitarsi with hairs about 1/2 of their length .....(14)
14. Posterior half of the head dorsum and anterior half of the mesosoma smooth and minutely punctate. Mid basitarsi with hairs 2/3 of their length and hind basitarsi with hairs 1/2 of their length. Mexico, Belize, Guatemala, Honduras, Costa Rica and Colombia .....*manicum*  
 - Posterior half of the head dorsum and anterior half of the mesosoma with marked sculpture. Mid basitarsi with hairs at most 1/2 of their length. United States and Canada.....(15)
15. Frontal area about 1/4 of HW and the carinae gently diverging posteriorly (Fig. 165). Standing hairs on the postpetiole and gaster sparse and short. United States .....*crassicorne*  
 - Frontal area broader than 1/4 of HW and the frontal carinae strongly diverging on the two anterior thirds (Fig. 159). Standing hairs on the postpetiole and gaster denser and longer. Southern Canada and United States ....  
 .....*silaceum*
16. Eyes composed by a single convex facet (Fig. 43). Frontal carinae broad and strongly diverging posteriorly (Figs. 52, 56). Erect hairs dense and long (Figs. 51, 52, 56). Sculpture densely granulate-foveolate.....(17)  
 - Eyes absent or composed of an agglomeration of minute ommatidia at most (Fig. 98). Frontal carinae narrow and gently diverging posteriorly (Figs. 86, 99). Erect hairs absent or, at most, sparse and short (Figs. 86, 92). Sculpture at most reticulate-punctate and granulate .....(20)
17. Fore tibiae without thick basal spine. Palp formula 3,2.....(18)  
 - Fore tibiae with a thick basal spine. Palp formula 4,3.....(19)
18. Clypeus surrounding the antennal sockets, subrectangular and protruding anteriorly. Propodeal dorsum with a median swelling. Colombia..*transitionis*  
 - Clypeus not surrounding the antennal sockets, reduced medially and triangular. Propodeal dorsum without swelling. Venezuela .....*littkei*

19. Sides of the propodeum with an obtuse angle. Ventral process of the petiole at most shortly triangular. Postpetiole about 1/4 shorter than the first gastral tergite. Costa Rica.....*goliath*  
 - Sides of the propodeum with a tooth. Ventral process of the petiole distinct and spiniform. Postpetiole about 1/7 shorter than the first gastral tergite. Mexico.....*tio*
20. Propodeal suture impressed. Clypeus anteromedially triangular. Propodeal sides without lamellae. Long hairs subdecumbent or decumbent, rare on the antennae and absent from the legs. United States (California).....*californicum*  
 - Propodeal suture absent. Clypeus anteromedially rectangular. Propodeal sides with lamellae. Long hairs suberect and distributed on the whole body .....(21)
21. Scapes much short of the vertexal margin. First funicular joint about 1/5 longer than broad. Funicular joints 2-10 about as long as broad or slightly broader than long. Mid basitarsi shorter than fore basitarsi. First gastral tergite strongly angulate on the curvature .....(22)  
 - Scapes reaching or surpassing the vertexal margin. First funicular joint 1/2 longer than broad. Funicular joints 2-10 longer than broad. Mid basitarsi as long as or longer than the fore basitarsi. First gastral tergite at most weakly angulate on the curvature .....(23)
22. Gaster short, opaque, with dense and short hairs (Fig. 92). United States .....*pergandei*  
 - Gaster longer, shinier, with sparser and longer hairs (Fig. 99). United States .....*chickasaw*
23. Scapes surpassing the vertexal margin. TL  $\geq$  5.5 mm. United States.....*creek*  
 - Scapes reaching the vertexal margin. TL < 5.0 mm. United States (Texas) and North Mexico .....*compitale*

### Key to the *Proceratium* workers of the world

The worker of *longigaster* is not included in the key since we have not been able to examine this species. The species † *denticulatum*, † *dominicanum*, † *gibberum*, *lombokense* and *longiscapus* are equally excluded from the key since they are known on the gyne only.

1. Mid tibiae without a pectinate spur .....(2)  
 - Mid tibiae with a pectinate spur .....(12)
2. Propodeal dorsum with a swelling covered by short hairs only (Figs. 59, 63, 65) .....(3)  
 - Propodeal dorsum without swelling and covered by short and long hairs ..(6)
3. Gaster entirely sculptured (Figs. 59, 60) .....(4)  
 - Gaster sculptured only in the posterior half or less (Figs. 62, 65) .....(5)
4. Head and mesosoma reticulate-foveolate with superimposed granulation. Propodeal swelling broad and low. Ecuador.....*ecuadoriense*  
 - Head and mesosoma granulate only. Propodeal swelling narrow and high. Colombia .....*colombicum*
5. Petiole 1/5 longer than broad. Postpetiole shorter than 1/2 of the gastral tergite I (LT4). Postpetiole and gaster more convex. Colombia .....*catio*  
 - Petiole at most 1/8 longer than broad. Postpetiole slightly longer than 1/2 of the gastral tergite I (LT4). Postpetiole and gaster less convex. Brazil .....  
 .....*brasilense*
6. Mid basitarsi with no hairs long 1/2 of the mid basitarsal length .....(7)  
 - Mid basitarsi with at least one hair about 1/2 of the mid basitarsal length ...(8)
7. Postpetiole shorter than 1/2 of LT4. TL  $\geq$  3.70 mm. Dark ferruginous-brown. Dominican Republic .....*taino*  
 - Postpetiole about 1/2 of LT4. TL  $\leq$  3.00 mm. Light brown. Cuba ...*cubanum*
8. Area between the basal and declivous faces of the propodeum with a transversal carina angulate or denticulate laterally .....(9)



- Area between the basal and declivous faces of the propodeum with at most very superficial traces of transversal carina .....(10)

9. Postpetiole anterolaterally convex. IGR < 0.21. TL > 2.8 mm. Mexico .....*mexicanum*

- Postpetiole anterolaterally angulate. IGR > 0.23. TL < 2.5 mm. Dominican amber .....† *poinari*

10. Mesosoma in profile gently convex. Postpetiole in dorsal view more convex and slightly angulate anterolaterally. Body sculpture more marked. (Fig. 67) Costa Rica, ?Mexico .....*convexiceps*

- Mesosoma in side view more elongate. Postpetiole in dorsal view more rectangular and angulate anterolaterally. Body sculpture more superficial (Figs. 74, 78) .....(11)

11. TL  $\geq$  3.80 mm. WL  $\geq$  1.05 mm. Costa Rica, Panama.....*panamense*

- TL < 3.60 mm. WL  $\leq$  0.95 mm. Honduras, Costa Rica, Panama, Colombia, Venezuela. Texas?, Ecuador? .....*micrommatum*

12. Eyes composed by a single, large, convex facet (Fig. 43).....(13)

- Eyes absent or at most composed by an agglomeration of minute ommatidia (Fig. 98).....(24)

13. Fore tibiae without thick basal spine (Fig. 155). Palp formula 3,2 ....(14)

- Fore tibiae with a basal spine (Fig. 38). Palp formula 4,3 .....(15)

14. Clypeus surrounding the antennal socket, subrectangular and protruding anteriorly. Propodeal dorsum with a median swelling. Colombia.....*transitionis*

- Clypeus not surrounding the antennal socket, reduced medially and triangular. Propodeal dorsum without swelling. Venezuela .....*latkei*

15. Propodeal sides unarmed, convex in profile. Head, mesosoma, petiole and postpetiole foveolate.....(16)

- Propodeal sides at least with a well marked angle, or a small tooth or spine .....(17)

16. Integumental foveae smaller (Fig. 36). Pilosity denser and shorter. Gaster in side view convex. IGR 0.27-0.29. Mauritius.....*avium*  
 - Integumental foveae larger (Fig. 37). Pilosity sparser and longer. Gaster in side view less convex. IGR 0.31-0.34. Mauritius.....*avioide*
17. Gastral tergite I greatly hypertrophied and projecting posteriorly (Fig. 34). Funicular joints slightly longer than broad. Madagascar.....*diplopyx*  
 - Gastral tergite I round or angulate posteriorly; never projecting. Funicular joints broader than long.....(18)
18. Gastral tergite I angulate on the curvature (Fig. 48). Integument from head to gastral tergite I entirely foveolate. Sarawak.....*foveolatum*  
 - Gastral tergite I round on the curvature. Gastral tergite I at most punctate/reticulate.....(19)
19. Total length > 5.1 mm.....(20)  
 - Total length < 4.8 mm.....(21)
20. Propodeal sides with an obtuse angle only. Ventral process of the petiole reduced or in shape of a very short triangle. Postpetiole about 1/4 shorter than first gastral tergite. Costa Rica.....*goliath*  
 - Propodeal sides with a tooth. Ventral process of the petiole distinct and spiniform. Postpetiole about 1/7 shorter than first gastral tergite. Mexico.....  
 .....*tio*
21. Standing hairs short (Figs. 32, 33). Propodeal sides at most toothed (Figs. 32, 33). Propodeal lobes without or at most with a narrow lamellaceous expansion.....(22)  
 - Standing hairs longer (Figs. 39, 42). Propodeal sides spinose (Figs. 39, 42), only toothed in the smallest specimens of *stictum*. Propodeal lobes with broad lamellaceous expansions.....(23)
22. Postpetiole medially concave and laterally weakly lobate. Sculpture shallower. CI < 87. Australia (Northern Territory).....*cavinodus*  
 - Postpetiole medially straight and laterally convex. Sculpture deeper. CI > 91. Ghana.....*boltoni*

23. Hind basitarsi longer,  $HTiL/HBaL \geq 1.32$ . Cephalic sculpture superficial. Frontal carinae less divergent posteriorly. Australia (Queensland).....*stictum*  
 - Hind basitarsi shorter,  $HTiL/HBaL \leq 1.17$ . Cephalic sculpture deeper. Frontal carinae more divergent posteriorly. Borneo, Brunei, Malaysia (Sabah and Sarawak), Thailand and Singapore .....*deelemani*
24. Fore tibiae with basal spine (Fig. 38).....(25)  
 - Fore tibiae without basal spine (Fig. 155) .....(35)
25. Propodeal suture impressed.....(26)  
 - Propodeal suture absent .....(27)
26. Antennal socket surpassing the anterior border of the clypeus. Standing hairs suberect and present on the whole body including the antennae and the legs. Pakistan.....*confinium*  
 - Antennal socket not surpassing the anterior border of the clypeus. Standing hairs subdecumbent or decumbent, rare on the antennae and absent from the legs. United States (California).....*californicum*
27. Clypeus anteriorly triangular.....(28)  
 - Clypeus anteriorly rectangular.....(29)
28. Head granulopunctate. Petiole slightly longer than broad. Second tarsomere of hind legs about as long as the pretarsus. Japan.....*morisitai*  
 - Head reticulopunctate. Petiole about as broad as long. Second tarsomere of hind legs about 1/5 longer than the pretarsus. Central and Southern Europe, Turkey.....*melinum*
29. Mid basitarsi shorter than fore basitarsi. First gastral tergite strongly angulate on the curvature .....(30)  
 - Mid basitarsi as long as or longer than the the fore basitarsi. First gastral tergite convex or, at most weakly angulate .....(31)
30. Gaster short, opaque, with dense and short hairs (Fig. 92). United States .....*pergandei*

- Gaster long, shining, with sparse and long hairs (Fig. 99). United States  
.....*chickasaw*
31. First funicular joint 1/2 longer than broad. Funicular joints 2-10 longer than broad. Gaster weakly angulate on the curvature .....(32)  
- First funicular joint at most 1/3 longer than broad. Funicular joints 2-10 about as broad as long. Gaster strongly convex but without angle on the curvature.....(33)
32. Scapes surpassing the vertexal margin. TL  $\geq$  5.5 mm. United States.....  
.....*creek*  
- Scapes reaching the vertexal margin. TL < 5.0 mm. United States (Texas) and North Mexico .....*compitale*
33. Propodeal lamellae absent. Head with sub-parallel sides. Body sculpture superficial. Malta and Sicily .....*melitense*  
- Propodeal lamellae well developed. Head strongly narrowing posteriorly. Body sculpture deeper.....(34)
34. Mesosoma, petiole and postpetiole deeply granulpunctate. Body dark ferrugineous. Japan, Korea (and China?).....*watasei*  
- Mesosoma, petiole and postpetiole punctate. Colour light brown. Italy, Croatia, Greece, Algeria, Morocco and Tunisia .....*algericum*
35. Frontal carinae very close to each other and posteriorly attached .....(36)  
- Frontal carinae far from each other and posteriorly diverging .....(38)
36. Head and mesosoma strongly and irregularly foveolate. Genal carinae strongly impressed. Propodeal lamellae developed. First gastral sternite flat. Postpetiole and first gastral tergite covered by foveae. Sabah ...*microsculptum*  
- Head and mesosoma granulate. Genal carinae absent. Propodeal lamellae absent. First gastral sternite tooth-shaped and projecting anteriorly. Postpetiole and first gastral tergite without foveae .....(37)
37. Head and mesosoma with suberect hairs. Kenya .....*toschii*  
- Head and mesosoma with subdecumbent or decumbent hairs. Cameroon ..  
.....*terrioni*

38. Head, mesosoma, petiole and postpetiole covered by granulation only. Clypeus anteromedially with a triangular tooth. Posterior border of the first gastral tergite without macula visible in transparency .....(39)  
 - Head, mesosoma, petiole and postpetiole never covered by granulation only. Clypeus anteromedially at most with a subround small tooth. Posterior border of the first gastral tergite with a clear macula visible in transparency .....(41)
39. Body hairs short, decumbent or appressed. Bhutan.....*bhutanense*  
 - Body with long standing hairs .....(40)
40. Propodeal sides at most with a narrow lamella surrounding the propodeal lobe only. Mid basitarsi with hairs shorter than 1/2 of the mid basitarsus length. Palp formula 4,3. Japan, Korea?, China?.....*itoi*  
 - Propodeal sides with a broad lamella on their whole length. Mid basitarsi with hairs 1/2 of the mid basitarsus length. Palp formula 3,2. Malaysia.....  
 .....*malesianum*
41. Lower mesopleura inflated (Figs. 121, 122, 124). Clypeus either with a small median subround projection or, if straight, minutely crenulate. Palp formula 3,2 or 4,3. Mandibular base without macula. Petiole with a neck.....(42)  
 - Mesopleura never inflated (Figs. 139, 146, 159). Clypeus weakly concave or, if straight, never crenulate. Palp formula 2,2. Mandibular base with a light macula. Petiole without neck .....(45)
42. Mesosoma and petiole with very superficial traces of foveae. Petiolar dorsum postero-medially with a large, transparent blister below the integument. Lower mesopleurae entirely inflated. Palp formula 4,3. Israel.....*galilaeum*  
 - Head, mesosoma, petiole, postpetiole and gaster with foveae variably impressed. Petiolar dorsum postero-medially with at most an irregular point. Lower mesopleurae inflated posteriorly only. Palp formula 3,2 .....(43)
43. Integumental foveae superficial. First gastral tergite longer than 1/4 of the postpetiole. Zimbabwe .....*arnoldi*  
 - Integumental foveae deep. First gastral tergite short, 1/7 or less of the postpetiole .....(44)

44. Integumental foveae small. Gastral sculpture superficial (Fig. 122). Burundi .....*burundense*  
 - Integumental foveae large and deep. Gastral sculpture deep (Fig. 121). Cameroon.....*lunatum*
45. Petiole in profile triangular and clearly narrowing apically (Figs. 126, 127) .....(46)  
 - Petiole in profile rectangular (Figs. 141, 148) .....(47)
46. Lateral expansions of the frontal carinae broad and far from each other. Head with dense punctures (Fig. 126). SI > 76. TL > 4.5 mm. Fiji Islands ...  
 .....*relictum*  
 - Lateral expansions of the frontal carinae narrow and close each other. Head with sparse punctures (Fig. 127). SI < 73. TL < 3.7 mm. Fiji Islands ..  
 .....*oceanicum*
47. Postpetiole concave and laterally lobate in dorsal view. Posterior border of first gastral tergite with a fold. Head, mesosoma, petiole, postpetiole and gaster strongly sculptured. First gastral tergite with traces of longitudinal rugosities .....(48)  
 - Postpetiole in dorsal view neither concave nor laterally lobate. Posterior border of first gastral tergite not folded. Head, mesosoma, petiole, postpetiole and gaster less strongly sculptured. First gastral tergite without traces of longitudinal rugosities .....(49)
48. Frontal area at least 1/3 of the head width. Propodeal sides with at most a small denticle. Rugosities on the first gastral tergite irregular and thin (Fig. 146). SI < 65. Sarawak .....*angulinode*  
 - Frontal area about 1/4 of the head width. Propodeal sides with a broad, lamelliform tooth. Rugosities on the first gastral tergite regular and thick (Fig. 147). SI > 74. Sarawak .....*striativenter*
49. CI < 85. Australia (New South Wales) .....*gigas*  
 - CI > 89 .....(50)
50. TL ≤ 2.3 mm. Frontal area about 1/4 of HW; .....(51)  
 - TL ≥ 2.37 mm if the TL approaches 2.3 mm, (*papuanum* specimens can vary between 2.37-2.59 mm), then the frontal area about 1/3 of HW .....(52)

51. Head and mesosoma with marked reticulation. Petiole more than 1 and 1/2 broader than long.  $CI \geq 100$ . Papua New Guinea .....*snellingi*  
 - Head and mesosoma with superficial punctures. Petiole 1 and 1/2 broader than long.  $CI < 95$ . Papua New Guinea.....*ivimka*

52. Species with the combination of the following characters: frontal area slightly narrower than 1/3 of HW; TL varying between 2.3 and 2.7 mm; petiole at least 1 and 1/2 broader than long ( $PeW \leq 0.27$  mm); propodeal sides at most denticulate;  $HBaL \leq 0.24$ ; mid basitarsi with a hair at least 2/3 of basitarsal length; hind basitarsi with a hair at least 1/2 of its length (Fig. 134). Papua New Guinea, Philippines, Sumatra, Malaysia, Sabah and Solomon Islands.....*papuanum*  
 - Species without the above mentioned combination of characters .....(53)

53. Species with the combination of the following characters: frontal area at most 1/4 of HW. TL 2.4 - 2.7 mm; petiole more than 1 and 1/2 broader than long ( $PeW 0.33$  mm);  $HBaL \leq 0.26$ ; mid basitarsi with hairs shorter than 2/3 of their length; hind basitarsi with hairs shorter than 1/2 of their length (Fig. 138). Queensland (Australia).....*pumilio*  
 - Species without the above mentioned combination of characters .....(54)

54. Species with the following combination of characters:  $SI > 73$ ; body with many long, standing hairs; frontal area at least 1/3 of the maximum HW; propodeal sides at most subangulate (Fig. 135). Australia (Queensland).....*hirsutum*  
 - Species without the above combination of characters .....(55)

55. Species with the combination of the following characters: frontal area slightly less than 1/4 of maximum HW; petiole narrower than 1 and 1/2 of its length; integument smooth and shining (Fig. 132). New Caledonia.....  
 .....*caledonicum*  
 - Species without the above mentioned combination of characters .....(56)

56. Species with the following combination of characters: frontal area at least 1/3 of the maximum HW; petiole about 1 and 1/2 broader than its length; head, mesosoma, petiole, postpetiole and gaster smooth and shining (Fig. 131). New Caledonia.....*politum*

- Species without the above mentioned combination of characters .....(57)

57. Species with the following combination of characters: TL > 3.7 mm.; frontal area broader than 1/3 of the maximum HW; petiole less than 1 and 1/2 broader than long; mid basitarsi with hairs shorter than 1/2 of their length (Fig. 153). United States .....*croceum*

- Species without the above mentioned combination of characters .....(58)

58. Species with the following combination of characters: petiole less than 1 and 1/2 broader than long; frontal area 1/4 of HW; head, mesosoma, petiole and postpetiole densely granulpunctate; mid basitarsi with at least one hair 2/3 of their length; hind basitarsi with at least one hair 1/2 of their length. SI < 70. CI < 91 (Fig. 136). Thailand.....*siamense*

- Species without the above mentioned combination of characters .....(59)

59. Species with the following combination of characters: frontal area slightly narrower than 1/3 of the maximum HW; head densely punctate; mesosoma, petiole, postpetiole and gaster smooth and shining; SI > 70. CI > 94; propodeal sides clearly angulate or denticulate (Fig. 133). Malaysia (Pahang) .....*terraealtae*

- Species without the above mentioned combination of characters .....(60)

60. Species with the following combination of characters: hairs of mid basitarsi never longer than 1/2 of the basitarsal length; hind basitarsi with at least a hair slightly longer than 1/3 of their length.....(61)

- Species with the combination of the following characters: mid basitarsi with at least a hair 2/3 of their length; hind basitarsi with at least a hair about 1/2 of their length .....(67)

61. Propodeal sides at most angulate. Postpetiole and gaster smooth and shining .....(62)

- Propodeal sides with a small denticle, if subangulate, the postpetiole is always sculptured .....(63)

62. Standing hairs on the gaster very sparse and suberect. Mid basitarsi with hairs at most 1/3 of the basitarsal length. CI < 93. SI > 68. Australia (Queensland).....*gracile*



- Standing hairs on the gaster denser, subdecumbent and decumbent. Mid basitarsi with hairs about 1/2 of the basitarsal length. CI > 94. SI < 65. Australia (New South Wales) .....*robustum*
63. Species with the following combination of characters: frontal area 1/3 HW; PeW  $\leq$  0.29 mm; postpetiole very sparsely granulopunctate (Fig. 142). Tunisia, Cyprus, Algeria, Turkey and Albania .....*numidicum*  
- Species without the above mentioned combination of characters .....(64)
64. Mesosoma and postpetiole strongly granulopunctate (Figs. 129, 143) ....  
.....(65)  
- Mesosoma and postpetiole less strongly granulopunctate (Figs. 159, 165) .....  
.....(66)
65. Frontal area 1/4 of HW (Fig. 129). Colour dark ferruginous. Sarawak ..  
.....*dayak*  
- Frontal area slightly narrower than 1/3 of HW (Fig. 143). Colour yellow to brown. Japan, Taiwan.....*japonicum*
66. Frontal area about 1/4 of HW and frontal carinae gently diverging posteriorly (Fig. 165). Standing hairs on the postpetiole and gaster sparser and shorter. United States.....*crassicorne*  
- Frontal area larger than 1/4 of HW and frontal carinae strongly diverging on the anterior two-thirds (Fig. 159). Standing hairs on the postpetiole and gaster denser and longer. South Canada and United States .....*silaceum*
67. Mesosoma, petiole and postpetiole minutely punctate only. Papua New Guinea, and Solomon Islands? .....*austronesicum*  
- Mesosoma, petiole and postpetiole densely punctate and variably granulate .....(68)
68. Posterior half of the head dorsum and anterior half of the mesosoma smooth and minutely punctate. Petiole less than 1 and 1/2 broader than long. Mexico, Belize, Guatemala?, Honduras, Costa Rica and Colombia...*manicum*  
- Species without the above mentioned combination of characters .....(69)
69. CI > 98. Sarawak (Malaysia).....*sulawense*  
- CI < 97 .....(70)

70. IGR 0.44. First gastral tergite strongly convex (Fig. 148). Sabah .....  
.....*banjaranense*  
- IGR  $\geq$  0.48. First gastral tergite less convex (Figs. 137, 149) .....(71)
71. Mesosoma, petiole and postpetiole densely granulpunctate. Sabah .....  
.....*dusun*  
- Mesosoma, petiole and postpetiole punctate and sparsely granulate. Aus-  
- tralia (Queensland, New South Wales) .....*australe*

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## ABSTRACT

The ant genus *Proceratium* is revised. 78 species, 45 of which are described for the first time in the present study, are recognised. One previously described species is recognised as valid but is not explicitly taken into account since we were unable to examine material referable to it. Four species are extinct, three from Dominican amber and one from Dominican and Mexican amber. The new species are: *creek* (United States), *chickasaw* (United States), *melitense* (Malta and Sicily), *confinium* (Pakistan), *bhutanense* (Bhutan and North India), *malesianum* (Malaysia), *avioide* (Mauritius), *gibberum* (Dominican amber), *cavinodus* (Australia), *foveolatum* (Borneo), *catio* (Colombia), *colombicum* (Colombia), *ecuadoriense* (Ecuador), *panamense* (Panama), *mexicanum* (Mexico), *dominicanum* (Dominican amber), *taino* (Dominican Republic), *cubanum* (Cuba), *longiscapus* (Dominican Republic), *poinari* (Dominican amber), *latkei* (Venezuela), *transitionis* (Colombia), *microsculptum* (Sabah), *burundense* (Burundi), *galilaeum* (Israel), *angulinode* (Sarawak), *striativenter* (Sarawak), *banjaranense* (Sabah), *dusun* (Sabah), *snellingi* (Papua New Guinea), *sulawense* (Sulawesi), *siamense* (Thailand), *australe* (Australia), *terraealtae* (Malaysia), *caledonicum* (New Caledonia), *ivimka* (Papua New Guinea), *oceanicum* (Fiji), *austronesicum* (Papua New Guinea), *pumilio* (Australia), *dayak* (Sarawak), *politum* (New Caledonia), *hirsutum* (Australia), *robustum* (Australia), *gracile* (Australia), *gigas* (Australia).

A cladistic analysis including also representatives of the two other genera of the tribe Proceratiini was performed on the basis of 62 morphological characters. The results allow a clear definition of the genus drawn from three synapomorphic characters and the recognition within it of eight phylogenetically significant clades.

The internal phylogeny of the genus resulting from the cladistic analysis was used also to trace the most parsimonious evolution of the most striking trait of this genus, the downward curved gaster. This shows a regular increase of the curvature along the phylogeny of the genus with two homoplastic increases and at least one secondary reduction of the curvature.

Construction of a simple dispersal model assigning lower cost to dispersal between contiguous regions and higher cost to dispersal between distant regions strongly suggests that the genus *Proceratium* should have originated in the Afrotropical region.

Key to the species based on workers are presented for the different biogeographic regions and one, of more difficult use, for the whole genus.

## RIASSUNTO

Si rivede il genere *Proceratium* su scala mondiale e si riconoscono 78 specie valide 45 delle quali descritte per la prima volta in quest'opera. Una sola specie, già nota di letteratura, è riconosciuta come valida ma è stata esclusa dall'analisi a causa della nostra incapacità di esaminare materiale ad essa riferibile. Quattro delle specie considerate sono estinte, tre dell'ambra dominicana ed una dell'ambra dominicana e messicana. Le specie descritte per la prima volta in questo studio sono: *creek* (Stati Uniti), *chickasaw* (Stati Uniti), *melitense* (Malta e Sicilia), *confinium* (Pakistan), *bhutanense* (Bhutan e India Settentrionale), *malesianum* (Malaysia), *avioide* (Is. Maurizio), *gibberum* (ambra dominicana), *cavinodus* (Australia), *foveolatum* (Borneo), *catio* (Colombia), *colombicum* (Colombia), *ecuadoriense* (Ecuador), *panamense* (Panama), *mexicanum* (Messico), *dominicanum* (ambra dominicana), *taino* (Repubblica Dominicana), *cubanum* (Cuba), *longiscapus* (Repubblica Dominicana), *poinari* (ambra dominicana), *latkei* (Venezuela), *transitionis* (Colombia), *microsculptum* (Sabah), *burundense* (Burundi), *galilaeum* (Israele), *angulinode* (Saravak), *striativenter* (Saravak), *banjaranense* (Sabah), *dusun* (Sabah), *snellingi* (Papua Nuova Guinea), *sulawense* (Sulawesi), *siamense* (Tailandia), *australe* (Australia), *terraealtae* (Malaysia), *caledonicum*

(Nuova Caledonia), *ivimka* (Papua Nuova Guinea), *oceanicum* (Isole Figi), *austronesicum* (Papua Nuova Guinea), *pumilio* (Australia), *dayak* (Saravak), *politum* (Nuova Caledonia), *hirsutum* (Australia), *robustum* (Australia), *gracile* (Australia), *gigas* (Australia).

Sulle specie considerate e su rappresentanti degli altri due generi di Proceratiini è stata condotta anche un'analisi cladistica basata su 62 caratteri morfologici. I risultati permettono una ridefinizione inequivoca del genere *Proceratium* basata su tre caratteri sinapomorfici ed il riconoscimento, al suo interno, di otto gruppi di specie filogeneticamente particolarmente significativi.

La filogenesi del genere risultante dall'analisi è stata usata per tracciare l'evoluzione più parsimoniosa del tratto più appariscente del genere, il gastro curvo con l'aculeo diretto in basso. Il tracciato mostra un generale aumento della curvatura in sincronia con la ricostruzione filogenetica originatosi indipendentemente due volte nell'evoluzione del genere; al contrario, solo un caso di riduzione secondaria della curvatura può essere riconosciuto con certezza.

Si è poi costruito un semplice modello di dispersione geografica che assegna costi inferiori al trasporto tra due regioni vicine e doppi al trasporto tra regioni distanti. L'applicazione del modello alla filogenesi del genere permette la ricostruzione delle aree occupate ancestralmente da antenati di cui non si ha traccia. Tale ricostruzione contiene numerosi elementi che indicano un'origine africana dei *Proceratium*.

Si presentano anche tabelle per la determinazione delle specie basate sulle operaie, divise per regione biogeografica ed una tabella complessiva, per la fauna mondiale.

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## APPENDIX

www.Proceratium.com

In addition to the papers cited in our references a great diversity of information on *Proceratium* can be found on the World Wide Web. The contributions published in this form can not be considered as a publication for the purpose of the Nomenclature Rules. For this reason we cited no Internet documents in our revision.

For other purposes, however, they can be considered as relevant as a hypothesis or as a statement expressed as a personal communication or orally during a congress.

Serious doubts may arise when there are Web Pages containing information additional to, or different from, or contrasting with the one offered in the present revision.

Supporters of Internet Publishing claim its great usefulness in making available important information to scientists otherwise distant from big libraries or missing other search instruments.

We were inclined to think that the scientific information available on the Web would be better ignored than considered as a whole. In the following we will test this hypothesis.

## Methods

To substantiate the quantity and the quality of the information on *Proceratium* available on the Web we made an exhaustive Web Search for *Proceratium* in January 2002. The search was performed using the following search engines: Amazon, Ask Jeeves, Google, Look Smart, Lycos, NBCi, Netscape, Overture and WiseNut.

In doing so we learned to be circumspect. In a previous paper (de Andrade & Baroni Urbani, 1999) we corrected some erroneous information contained in a Web Page. After reading our paper, the author of the page changed it and stated plainly that we are the wrong ones since he never gave the erroneous accounts that we corrected.

This time we kept a complete electronic record of all the Web documents encountered during our search.

## Results

In the following we give a list of all the Web addresses and documents or parts thereof referred to *Proceratium* encountered during our search. They have been classified according to their information content as duplicate or original ones. Duplicate documents are those reporting information already published and available in another form. Original documents contain information not published elsewhere. The original documents have been further classified also for the quality of the information that they contain as erroneous, futile or correct. For obvious reasons of space and time our evaluation of long documents is limited to the part concerning *Proceratium*.

1. Anonymous. *Proceratium*.

<http://www.bdt.fat.org.br/zoologia/formiga/Procera.htm>

Contents: photograph of an unidentified species.

Information: original. Information quality: futile.

2. Anonymous. FL Species in Ponerinae.

<http://www.cs.unc.edu/~hedlund/nc.html>

Contents: three species of *Proceratium* already recorded from Florida are listed from Florida. No source.

Information: original. Information quality: futile.

3. Anonymous. Gênero *Proceratium* Roger (Ponerinae: Proceratiini).

<http://www.bdt.fat.org.br/zoologia/formiga/proceratium.htm>

Contents: web version of the Catalogue of Brandão, C. R. F. 1991: Rev. Bras. Ent., 35: 319-412, with the addition of *P. tio*.

Information: original. Information quality: correct.

4. Anonymous: GENUS *Proceratium* Index.

<http://nighimai.lab.nig.ac.jp/AZ/Australia/GENUS/Proceratium.html>

Contents: list of two *Proceratium* species.

Information: original. Information quality: futile.

5. Anonymous: Natural History Museum: Publications: Contributions in Science: Entomology.

[http://www.lam.mus.ca.us/research/publications/Contributions\\_in\\_Science/catalog/pubent.html](http://www.lam.mus.ca.us/research/publications/Contributions_in_Science/catalog/pubent.html)

Contents: list of papers published by the Natural History Museum of Los Angeles including one on *Proceratium*.

Information: original. Information quality: correct.

6. Anonymous: Entomology - Type List - Hymenoptera - Formicidae.

<http://www.lam.mus.ca.us/research/entomology/types/formicidae.html>

Contents: list of ant types in the Natural History Museum of Los Angeles including two of *Proceratium*.

Information: original. Information quality: correct.

7. Anonymous: Nomina - Hymenoptera: F-I.  
<http://www.nearctica.com/nomina/wasps/waspf-i.htm>  
 Contents: list of ant names including 6 *Proceratium*.  
 Information: original. Information quality: correct.
8. Anonymous: California Department of Fish and Game - Animals of Special Concern.  
<http://www.dfg.ca.gov/endangered/invert.html>  
 Contents: list of species including *P. californicum*.  
 Information: original. Information quality: correct.
9. Anonymous: ENTOMOLOGY SECTION - LIST OF PUBLISHED PAPERS of Roy R. Snelling.  
<http://www.nhm.org/research/entomology/associates/snellingpubs.html>  
 Contents: list of publications.  
 Information: original. Information quality: correct.
10. Anonymous: Fragmenta 30.  
<http://www.scienzemfn.uniroma1.it/fragmenta/ind-30.htm>  
 Contents: Abstract and Riassunto of de Andrade, M. L. 1998: First fossil records of the ant genus *Discothyrea* in Dominican and Mexican amber. *Fragm. Ent.* 30: 201-214.  
 Information: duplicate.
11. Anonymous: Ponerinae: key to the genera couplet 1.  
<http://www.geocities.com/huux0058/AntkeyTW/Ponerinae1.html>  
 Contents: Couplet of a key. After reaching *Proceratium* one cannot proceed.  
 Information: original. Information quality: correct.
12. Anonymous: California's Endangered Insects - Hymenoptera - Proposed for listing.  
<http://www.mip.berkeley.edu/essig/endins/hymenop.htm>  
 Contents: Proposal of listing *P. californicum* as endangered species. Equivalent to Williams at a different Web address.  
 Information: original. Information quality: correct.
13. Anonymous: List of collaborators.  
<http://www.uky.edu/~mjshar0/colombia/list.html>  
 Contents: list of collaborators one of which is studying *Proceratium*.  
 Information: original. Information quality: correct.
14. Anonymous: Annales de la Société Entomologique de France.  
<http://ann.sef.free.fr/fasc35-2.html>  
 Contents: Résumé and Abstract of Perrault, G. H. 1999: L'architecture thoracique associée à la jonction ponoto-mésothoracique des ouvrières de fourmis [Hymenoptera: Formicidae]. Intérêt pour la phylogénie du groupe. *Ann. Soc. ent. Fr.*, 35: 125-163.  
 Information: duplicate.
15. Anonymous: the Order hymenoptera ants, bees, wasps.  
<http://chinareason.tripod.com/anthropoda/insecta/hymenoptera/hymenoptera.html>  
 Contents: the name *Proceratium* occurs in a citation that we are unable to understand.  
 Information: duplicate.
16. Anonymous: Untitled Document.  
<http://entomology.ucdavis.edu/faculty/ward/JohnCV.html>  
 Contents: CV of John Lattke listing his papers on *Proceratium*.  
 Information: original. Information quality: correct.

17-18. Agosti, D. CEPEC Ponerinae.

[http://research.amnh.org/entomology/social\\_insects/tempcepecproc.html](http://research.amnh.org/entomology/social_insects/tempcepecproc.html) &  
[http://research.amnh.org/entomology/social\\_insects/tempcepecpone6.html](http://research.amnh.org/entomology/social_insects/tempcepecpone6.html)

Contents: photograph of two specimens of *P. brasiliense*. One of them is a *Discothyrea*.

Information: original. Information quality: erroneous.

19. Agosti, D. Key to the Malagasy ant genera by Brian Fisher.

[http://research.amnh.org/entomology/social\\_insects/keyantmadagascar.html#pon6](http://research.amnh.org/entomology/social_insects/keyantmadagascar.html#pon6)

Contents: key to the identification of the Malagasy ant genera.

Information: original. Information quality: correct.

20. Agosti, D. Images of ants at the Museu de Zoologia, São Paulo.

[http://research.amnh.org/entomology/social\\_insects/zmusp](http://research.amnh.org/entomology/social_insects/zmusp).

Contents: Images of ant species taken by C. R. F. Brandão including the species described in this paper as *P. mexicanum* [given as *micrommatum*].

Information: original. Information quality: correct.

21. Agosti, D. AMNH ANTS - The Ants at the American Museum of Natural History. This is the list of ant taxa (species, subspecies) at the AMNH. Compiled by Marc Smethurst, 1996.

[http://research.amnh.org/entomology/social\\_insects/ants/amnhants.html](http://research.amnh.org/entomology/social_insects/ants/amnhants.html)

Contents: Catalog of Museum's ant collection.

Information: original. Information quality: correct.

22. Agosti, D. The Ants of Central Park, Long Island, and Southern New England, USA.

[http://research.amnh.org/entomology/social\\_insects/ants/centralp.html](http://research.amnh.org/entomology/social_insects/ants/centralp.html)

Contents: List of species compiled by S. Cover including *P. pergandei* and *silaceum*.

Information: original. Information quality: correct.

23. Agosti, D. & J. Carpenter. The Ant Types at the American Museum of Natural History (AMNH), New York.

[http://research.amnh.org/entomology/social\\_insects/ants/amnhatype3.html](http://research.amnh.org/entomology/social_insects/ants/amnhatype3.html)

Contents: type catalog.

Information: original. Information quality: correct.

24. Amberica West. Amber Collection For Sale or Purchase.

<http://www.americawest.com/collection.html>

Contents: Collection of amber including a *Proceratium* male for sale.

Information: original. Information quality: futile.

25. Archbold Biological Station, Biennial Report 1997.

<http://www.archbold-station.org/abs/Biennial97/R7Appen/R7AppenC.htm>

Contents: list of collaborators one of which is studying *Proceratium*.

Information: original. Information quality: correct.

26. Ascher, J. ESSIG MUSEUM HYMENOPTERA HOLDINGS: A GENERIC LIST.

<http://www.mip.berkeley.edu/essig/holdings/hymlist.htm>

Contents: list of genera in the museum's collection.

Information: original. Information quality: correct.

27. Asociación Entomológica Galega "Luis Iglesias".

<http://entomologia.rediris.es/aega/index.htm>

Contents: a fragmentary citation of *Proceratium* appears. We were unable to follow it.

Information: ?

28. Author? Title?

<http://www.erc.pref.fukui.jp/gbank/insect/order242.html>

Contents: Japanese document containing a list of species two of which are *Proceratium*.  
Information: ?

29-30. Brandão, C. R. F. Catálogos.

<http://www.bdt.fat.org.br/zoologia/formiga/catalogos.htm>

[http://research.amnh.org/entomology/social\\_insects/ponesam.html](http://research.amnh.org/entomology/social_insects/ponesam.html)

Contents: Web version of the Catalogue of Brandão, C. R. F. 1991: Rev. Bras. Ent., 35: 319-412, with the addition *P. tio*. No difference with the information available at:

<http://www.bdt.fat.org.br/zoologia/formiga/proceratium.htm>

Information: duplicate.

31. Coulson, R. N. FASIMS: Native and exotic ant species.

<http://fasims.tamu.edu/nativeexotic/>

Contents: a literature reference containing the name *Proceratium*.  
Information: duplicate.

32. Coulson, R. N. FASIMS: Native and exotic ant species module.

<http://fasims.tamu.edu/nativeexotic/list.asp>

Contents: *P. compitale* listed for two Texan counties and *pergandei* for three.  
Information: duplicate.

33. Delabie, J. H. The Ants of the major Vegetation Types in Southern Bahia, Brazil.

[http://research.amnh.org/entomology/social\\_insects/ants/itabant.html](http://research.amnh.org/entomology/social_insects/ants/itabant.html)

Contents: *P. brasiliense* recorded from two vegetation types in Bahia, Brazil.  
Information: original. Information quality: correct.

34. DuBois, M. Checklist of ants found at the Sun Foundation.

<http://www.sunfoundation.org/prod/Reference/antsSunFoundation.asp>

Contents: *P. silaceum* recorded from Marshall Co., Illinois.  
Information: original. Information quality: correct.

35. Ezboard. Complete list of genera.

<http://pub8.ezboard.com/fanifarmfrm4.showMessage?topicID=137.topic>

Contents: List of ant genera.  
Information: duplicate.

36-37. Hedlund, K. S. Index of Species-level Names in Subfamily Ponerinae.

<http://www.cs.unc.edu/~hedlund/ants/catalog/na/online/Ponerinae/index/SpIndex.html#>

<http://www.cs.unc.edu/~hedlund/ants/catalog/na/online/Ponerinae/html/Proceratiini.html>

Contents: list of 12 names (1 misspelled) and 7 distribution maps.  
Information: original. Information quality: correct.

38-40. Hedlund, K. S. Online Catalog of ants of North America.

<http://www.cs.unc.edu/~hedlund/PonFormDBout.html>

<http://www.cs.unc.edu/~hedlund/PonDBout.html>

<http://www.cs.unc.edu/~hedlund/genus.html> [not found]

Contents: catalog of species with distribution maps and references to biological information.  
Information: original. Information quality: correct.

41. Instituto Nacional de Biodiversidad. Lista de géneros.

<http://www.inbio.ac.cr/bims/k02/p05/c029/o0118/f01071.htm>

Contents: list of ant genera including *Proceratium*.  
Information: original. Information quality: futile.

42-261. Japanese Ant Database Group. Japanese Ants Image Database.

This site or parts thereof can be found at any one of the following links. The list may be incomplete.

<http://ant.edb.miyakyo-u.ac.jp/IMAGEE/00001.HTM>  
<http://riss.narc.affrc.go.jp/ant/ANT.WWW/PCD1328/PCD1328.HTM>  
[http://ant.fujimi.hosei.ac.jp/Ant.www/Find\\_E/gJG003.html](http://ant.fujimi.hosei.ac.jp/Ant.www/Find_E/gJG003.html)  
[http://www.genetics.or.jp/Ant.WWW/Taxo\\_J/F10304.html](http://www.genetics.or.jp/Ant.WWW/Taxo_J/F10304.html)  
<http://ant.fujimi.hosei.ac.jp/Ant.www/PCD1328/HTML/11.html>  
<http://133.5.200.60/Ant.WWW/GENUS/00001.HTM>  
<http://riss.narc.affrc.go.jp/ant/ANT.WWW/PCD1328/HTML/11.HTM>  
<http://ant.fujimi.hosei.ac.jp/Ant.www/PCD1328/HTML/12.html>  
[http://taxa.soken.ac.jp/Ant.WWW/Taxo\\_J/F103--.html](http://taxa.soken.ac.jp/Ant.WWW/Taxo_J/F103--.html)  
<http://ant.fujimi.hosei.ac.jp/Ant.www/PCD1328/HTML/08.html>  
<http://riss.narc.affrc.go.jp/ant/ANT.WWW/PCD1328/HTML/07.HTM>  
<http://ant.fujimi.hosei.ac.jp/Ant.www/PCD0419/HTML/97.html>  
<http://ant.fujimi.hosei.ac.jp/Ant.www/GENUS/00001F.HTM>  
<http://ant.fujimi.hosei.ac.jp/Ant.www/PCD1250/HTML/06.html>  
<http://www.genetics.or.jp/Ant.WWW/IMAGEE/00001.HTM>  
<http://133.5.200.60/Ant.WWW/PCD1328/HTML/12.HTM>  
<http://133.5.200.60/Ant.WWW/PCD1328/HTML/10.HTM>  
<http://riss.narc.affrc.go.jp/ant/ANT.WWW/IMAGEE/00001.HTM>  
<http://www.genetics.or.jp/Ant.WWW/PCD1328/HTML/05.HTM>  
<http://133.5.200.60/Ant.WWW/PCD1328/HTML/08.HTM>  
<http://133.5.200.60/Ant.WWW/PCD0419/HTML/97.html>  
<http://riss.narc.affrc.go.jp/ant/ANT.WWW/PCD1328/indexE.html>  
<http://ant.obihiro.ac.jp/Ant.WWW/PCD1328/HTML/08.html>  
[http://ant.obihiro.ac.jp/Ant.WWW/Find\\_E/gJG008.html](http://ant.obihiro.ac.jp/Ant.WWW/Find_E/gJG008.html)  
<http://www.genetics.or.jp/Ant.WWW/PCD1328/HTML/07.html>  
[http://133.5.200.60/ANT.WWW/Find\\_E/gJG009.html](http://133.5.200.60/ANT.WWW/Find_E/gJG009.html)  
[http://133.5.200.60/ANT.WWW/Find\\_E/gJG003.html](http://133.5.200.60/ANT.WWW/Find_E/gJG003.html)  
[http://133.5.200.60/ANT.WWW/Find\\_E/gJG005.html](http://133.5.200.60/ANT.WWW/Find_E/gJG005.html)  
<http://www.genetics.or.jp/Ant.WWW/PCD1328/HTML/10.html>  
[http://www.genetics.or.jp/Ant.WWW/Find\\_E/gJG002.html](http://www.genetics.or.jp/Ant.WWW/Find_E/gJG002.html)  
[http://www.genetics.or.jp/Ant.WWW/Find\\_E/gJG009.html](http://www.genetics.or.jp/Ant.WWW/Find_E/gJG009.html)  
<http://ant.fujimi.hosei.ac.jp/Ant.www/DOCS/TEXTS/KENSAKU/1/README.JXW>  
<http://www.genetics.or.jp/Ant.WWW/PCD0419/HTML/97.html>  
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Information: original. Information quality: correct.

268-269. Longino, J. T. Ants of Costa Rica: Subfamilies and Genera.

[http://www.evergreen.edu/user/serv\\_res/research/arthropod/Genera.html](http://www.evergreen.edu/user/serv_res/research/arthropod/Genera.html)

[http://www.evergreen.edu/user/serv\\_res/research/arthropod/genera/proceratium/key.html](http://www.evergreen.edu/user/serv_res/research/arthropod/genera/proceratium/key.html)

Contents: *P. goliath*, *P. micrommatum*, *P. silaceum* reported from Costa Rica. Information

complement: *P. goliath* is based on a literature record; we examined the specimens attributed to the other two species; *P. silaceum* is *P. mancum*, the record of *P. micrommatum* is based on specimens to be referred to three different species, i. e. *micrommatum*, *convexiceps* and *panamense*.

Information: original. Information quality: erroneous.

270. Longino, J. T. Picture Guide to the Ant Genera of Costa Rica.

[http://www.evergreen.edu/user/serv\\_res/research/arthropod/genusguide/genusguide1.html](http://www.evergreen.edu/user/serv_res/research/arthropod/genusguide/genusguide1.html)

Contents: Picture of a *Proceratium* sp.

Information: original. Information quality: correct.

271. Milosevic, B. O FAUNI MRAVA U HRVATSKOJ.

<http://www.agr.hr/hed/hrv/ento/inventar/formica.htm>

Contents: *Proceratium* sp. recorded from Croatia.

Information: original. Information quality: correct.

272. Morrison, L. W. Formicidae (Ants) of Brackeridge Field Laboratory

<http://www.utexas.edu/research/bfl/collections/ants.html>

Contents: list of species partly compiled and partly original.

Information: original. Information quality: correct.

273. Putter, T. (Ed.) Entity List.

[http://www.ecoport.org/EP.exe\\$EntTaxSrc?Taxon=Formicidae](http://www.ecoport.org/EP.exe$EntTaxSrc?Taxon=Formicidae)

Contents: list of species of unknown origin with Latin and common names with mistakes.

Information: original. Information quality: futile.

274. Shattuck, S. O. & N. J. Barnett. Australian Ants Online.

[http://www.ento.csiro.au/science/ants/genus\\_list.htm](http://www.ento.csiro.au/science/ants/genus_list.htm)

Contents: Short description of the genus with figures of an unidentified species (= *australe*) and references list.

Information: original. Information quality: correct.

275. Snelling, R. R. THE SOCIAL HYMENOPTERA (INSECTA) OF LAKEKAMU - THE SOCIAL HYMENOPTERA (INSECTA) OF LAKEKAMU.

<http://www.nhm.org/research/entomology/ants/index.html>

Contents: List of species including *Proceratium* sp.

Information: original. Information quality: correct.

276. South African Museum. Subfamily: Ponerinae.

<http://www.museums.org.za/bio/ants/ponerinae.htm>

Contents: List of genera.

Information: original. Information quality: futile.

277-278. Taylor, B. The Ants of West Africa.

<http://ibis.nott.ac.uk/~plzbt/wafants/clog11.htm>

<http://ibis.nott.ac.uk/~plzbt/wafants/contents.htm>

Contents: short generic diagnosis and list of three species resulting from the literature.

Information: duplicate.

279. Trager, J. C. A PRELIMINARY LIST OF ANTS OF THE ST. LOUIS REGION.

[http://research.ammh.org/entomology/social\\_insects/invtrager.html](http://research.ammh.org/entomology/social_insects/invtrager.html)

Contents: two *Proceratium* species recorded from Missouri.

Information: original. Information quality: correct.

280. Wheeler, G. C., Wheeler, J. N. & P. B. Kanno. CHECKLIST OF THE ANTS OF MICHIGAN (HYMENOPTERA: FORMICIDAE).

<http://insects.ummz.lsa.umich.edu/fauna/michants.html>

Contents: Web version of the paper printed in Great Lakes Ent., 1: 297-310.

Information: duplicate.

281. Ward, P. S. UCD Entomology: Ward Lab- Research Interests and Bibliography.

[http://entomology.ucdavis.edu/faculty/ward/res\\_int.html](http://entomology.ucdavis.edu/faculty/ward/res_int.html)

Contents: list of publications by P. S. Ward.

Information: original. Information quality: correct.

282. Ward, P. S. Ants (Hymenoptera: Formicidae) of Cold Canyon.

<http://nrs.ucop.edu/reserves/stebbins/ants.htm>

Contents: *P. californicum* recorded from Cold Canyon, California.

Information: original. Information quality: correct.

283. Williams, D. F. Other Listed and Candidate Species of the San Joaquin Valley California.

<http://arnica.csustan.edu/esrpp/others.htm>

Contents: *P. californicum* listed as endangered species in the San Joaquin Valley. Information complement: it must be very endangered since it was never collected in the Valley.

Information: original. Information quality: erroneous and misleading.

## Discussion

Our search resulted in 283 links to documents containing the name *Proceratium*. This multitude of addresses, in truth, corresponds to 57 different documents. Out of these 57 Web documents, 12 only were duplicate ones, i. e. the Web version of a paper existing also in print, and fulfilling in this way the presumed search facility function of the Web. To give a possible evaluation term, for the present revision, we referred to 98 scientific contributions on *Proceratium*. Only one of these contributions (the Japanese Ants Image Database) results also from the Web Search.

The remaining 45 documents were original ones, considering as original also compilations differing from other printed compilations. Original documents were classified according to their quality by means of generous criteria. In an attempt to take into account hypothetical Web Surfers who never saw a *Proceratium* or interested in very local faunal lists we classified as correct even documents containing tiny quantities of information that we personally regard as totally insignificant.

Even by applying such tolerant criteria, six original documents were futile and three erroneous.

## Conclusion

If we can consider the *Proceratium* case as representative, the information available simultaneously in print and on the Web represents ca. 1% of the printed data and by no means the most significant part of it. This easy access information on the Web, moreover, is diluted within an outweighing amount of supplementary facts of doubtful value and relevance.

We strongly advise scientists seeking to know the state of the art on a biological subject whatever to use any information source different from a Web Search. No one of the available sources is perfect. But any one will give better results. There are many possibilities including excellent, specialised databases accessible on the Web.

While progressing in our search we planned to invite the persons convinced to have something worth to be said to use more traditional communication means instead of the Web.

We understood lately that it is already so.

Our next wish, hence, will be that Institutions supporting Web Pages similar to the majority of those encountered during our search may succeed in diverting the manpower and the energies necessary to the construction and maintenance of these pages into more profitable activities.

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