NUMBER 495
22 NOVEMBER 2002

CONTRIBUTIONS IN SCIENCE

A TAXONOMIC REVISION OF THE *PROCRYPTOCERUS* (HYMENOPTERA: FORMICIDAE) OF CENTRAL AMERICA

JOHN T. LONGINO AND R. R. SNELLING

NATURAL HISTORY MUSEUM
OF LOS ANGELES COUNTY

A Taxonomic Revision of the *Procryptocerus* (Hymenoptera: Formicidae) of Central America

John T. Longino[1] and R. R. Snelling[2]

ABSTRACT. The Central American species of the Neotropical ant genus *Procryptocerus* Emery, 1887 (Myrmicinae, Cephalotini), are revised, with a worker-based key to species and individual accounts for 14 species. Species accounts include distribution, habitat affinities, nesting habits, and, in some cases, descriptions of nest contents. The following taxonomic changes are made: *P. reichenspergeri* Santschi, 1921, is synonymized under *P. mayri* Forel, 1899; *P. convexus* Forel, 1904, is raised to species; *P. impressus* Forel, 1899, is removed from synonymy and raised to species; and *P. laeviventris* Forel, 1899, is transferred from synonymy under *P. carbonarius* to synonymy under *P. batesi*. Four new species are described: *P. eladio*, *P. kempfi*, *P. nalini*, and *P. tortuguero*.

RESUMEN. Las especies de América Central del género Neotropical de hormigas *Procryptocerus* Emery, 1887 (Myrmicinae, Cephalotini), son revisadas, con una clave de especies y citas de 14 especies. Las citas de especies incluyen distribución, afinidades de hábitat, hábitos de anidamiento, y, en algunos casos, descripciones del los contenidos del nido. Se hacen los siguientes cambios taxonómicos: *P. reichenspergeri* Santschi, 1921 es sinonimizado con *P. mayi* Forel, 1899; P. convexus Forel, 1904 es elevado a especie; *P. impressus* Forel, 1899 es retirado de sinonimia y elevado a especie; y *P. laeviventris* Forel, 1899 es transferido de sinonimia bajo *P. carbonarius* a sinonimia bajo *P. batesi*. Se describen cuatro especies nuevas: *P. eladio*, *P. kempfi*, *P. nalini*, y *P. tortuguero*.

INTRODUCTION

The ant tribe Cephalotini, subfamily Myrmicinae, is a group of Neotropical, stem-nesting ants. A unique proventriculus (Emery, 1924) may be supposed synapomorphic, establishing the tribe as a monophyletic lineage. In addition, deep antennal scrobes, nonpedunculate petiole, relatively large size, and elaborate sculpture proffer a characteristic habitus. Brown (1973) attempted to reduce the Cephalotini to two genera, *Procryptocerus* Emery, 1887, and *Cephalotes* Latreille, 1802, but Kempf (1973) persevered in the retention of four genera: *Procryptocerus*, *Cephalotes*, *Eucryptocerus* Kempf, 1951, and *Zacryptocerus* Wheeler, 1911. Andrade and Baroni Urbani (1999) recently evaluated the monophyly of *Cephalotes*, *Eucryptocerus*, and *Zacryptocerus* and concluded that Brown's proposal was correct, and they formally synonymized *Eucryptocerus* and *Zacryptocerus* under *Cephalotes*. Thus, the Cephalotini now contains two genera, *Procryptocerus* and *Cephalotes*, with *Cephalotes* being demonstrably monophyletic.

The genus *Procryptocerus* can be separated from *Cephalotes* (in the broad sense of Andrade and Baroni Urbani, 1999) by the combination of the following worker and queen characters: (1) antennal scrobe extending almost to margin of vertex, (2) eyes situated below the scrobe, (3) frontal carinae not covering the genae from above, (4) pronotum without spines or teeth, (5) metatarsus not compressed, and (6) petiole and postpetiole without projecting spines, teeth, or tubercles (Kempf, 1951). *Procryptocerus* workers are strictly monomorphic (Wheeler, 1984). The larvae of several species of *Procryptocerus* have been described by Wheeler and Wheeler (1954, 1973), but no features unique to the genus have been identified. Although the above characters allow a clean separation of *Procryptocerus* and *Cephalotes*, it remains unknown whether any of them are synapomorphic. Thus it is unknown whether *Procryptocerus* is monophyletic or the paraphyletic remainder of the Cephalotini after *Cephalotes* is removed.

Kempf (1951) revised the genus, and subsequently published short addenda describing new species, making minor taxonomic changes, and providing new locality data (Kempf, 1957, 1960, 1964a, 1964b, 1969). The treatment of the Central American region, in particular, suffered from a severe paucity of material, and many of the taxa Kempf treated were known to him only by the type series (often a single specimen) or by brief published descriptions. The accrual of new material from Central America revealed problems in using Kempf's key to species (1951:19). Some of the characters to

1. Corresponding author: The Evergreen State College, Olympia, Washington 98505. Research Associate, Natural History Museum of Los Angeles County.

2. Research Associate, Natural History Museum of Los Angeles County, 900 Exposition Boulevard, Los Angeles, California 90007.

Contributions in Science, Number 495, pp. 1–30
Natural History Museum of Los Angeles County, 2002

which Kempf gave primary importance, such as propodeal dimensions, spine length and degree of divergence; the shape of the frontal carinae; and the degree of excavation of the propleura, have proved difficult to interpret, vary within species, or both, whereas pilosity characters, which Kempf largely ignored, have proved valuable in species diagnoses. Also, we have examined type specimens of most *Procryptocerus* nominal taxa, many of which were not examined by Kempf. The new Central American material, the reevaluation of characters, and the examination of types warrant a review of the Central American species of the genus.

Many systematists would prefer a monographic revision of the entire genus to this geographically restricted work. But the geographic restriction is necessary and may even be preferable to a single work on the entire genus. A well-known phenomenon to monographers is character variation that cleanly separates species locally but blurs when viewed over the entire range of a genus. We continually search for characters, often quite obscure, that will cut through the geographic variation and reveal true species over broad geographic areas. This endeavor can be successful, leading to keys that allow a specialist to identify any specimen, but the keys are often unusable by the nonspecialist and may ignore more conspicuous characters that cleanly separate species in geographically restricted areas.

We prefer the approach of O'Hara (1993), in which species are defined as a cartographic generalization, like "road" or "city." These terms do not refer to precisely defined real entities, but nevertheless are very useful generalizations for symbols on a map. The nature of a map, and in particular its spatial scale, is usually tailored to a particular set of users. The need for local maps to biodiversity is increasing, but taxonomists insist on only creating maps for small fractions of the biota and waiting until they can produce a fine-scale map for an enormous area.

This work provides a biodiversity map for *Procryptocerus* in Central America, made possible by abundant collections from Costa Rica. Central America is defined as Panama to Mexico, and all species heretofore recorded from this region are included in this report. The impetus for the project has been the immediate needs of Costa Rica's biodiversity inventory (Gámez, 1991). Kempf's original key to species (1951) uses major dividing characters that are quite different from our key to the Central American species; thus, the two keys cannot be easily fused. In this report, the key is followed by a taxonomic synopsis and species accounts. We attempt to make global definitions of species, recognizing them as suites of characters that are coherent over a particular area. Species accounts encompass the entire range and not just the Central American occurrences of species. Species accounts and taxonomic notes are also provided for several exclusively South American species that are very closely related to Central American species.

For those needing to identify South American *Procryptocerus*, a combination of this key and Kempf (1951) will serve to identify many of the common species, especially in Amazonia and southeastern Brazil. However, northern South America and the Andes are poorly collected, and many taxonomic problems remain in these regions.

This work relies almost entirely on worker characters. Queens are similar to workers in most respects. Queen head width is 1 to 1.16 times worker head width. The face sculpture is usually the same, although subtle differences may occur. The main differences are the caste-specific structural differences of the mesosoma. Although the key is for workers and all species limits are justified with worker evidence, we have provided measurements and brief descriptions for queens when available. We have completely ignored males in our research, but increasing numbers of worker-associated males are available in collections. In future work, males could prove valuable, expanding our current knowledge of species boundaries and phylogenetic relationships.

METHODS

Observations were made at ×63 magnification with a Zeiss dissecting microscope. Most measurements were made with a micrometer stage with digital output in increments of 0.0001 mm. However, variation in specimen orientation and alignment of crosshairs with edges of structures resulted in measurement accuracy to the nearest 0.005 mm. All measurements are presented in millimeters.

TERMINOLOGY AND ABBREVIATIONS

The head is assumed prognathous. The mandibles and clypeus are anterior. The face (= frons) is dorsal. The vertex is posterior. The occiput and genal bridge are ventral. The face and vertex are often sharply differentiated, meeting at an angle. The juncture is termed the vertex margin. The vertex is delimited ventrally by the occipital carina. In "face view" the anterior margin of clypeus and margin of vertex are in the same plane of focus.

An important character system that may have phylogenetic significance is the structure of the frontal carinae and their relationship to the torulus. In some species, the frontal carina is a thin flange that forms the upper scrobe margin, continues above the torulus, curves medially, and continues onto the clypeus as a lateral carina. The carina is separate from the dorsal margin of the torulus. A character series can be seen in which the carina becomes thinner where it crosses the torulus, eventually becoming discontinuous from the lateral clypeal carina and fusing with the dorsal margin of the torulus. The frontal carina then appears to end on the torulus. This is accompanied by a thickening of the margin of the frontal carina just posterior to its contact with the torulus.

True abdominal segment one is the propodeum, segment two is the petiole, segment three is the postpetiole. Subsequent segments comprise the gaster. The postrergite (sensu Bolton, 1994) of abdominal segment four is referred to as the first gastral tergite. Pretergites and postergites of gastral segments two, three, and four are sharp-

ly differentiated by a pronounced carina. The pretergite is smooth and shiny, the posttergite is variously sculptured. The posttergite of the first gastral segment and the pretergite of the second are very tightly overlapping, and it may appear that the posttergite has a thin, smooth band at the posterior margin. In other words, the juncture between the pre- and posttergites of the second gastral segment may be mistaken for the posterior margin of the first gastral segment.

MATERIALS

Sculpture terminology generally follows Harris (1979). The following measurements are reported.

AL Length of first gastral tergite measured in dorsal view along median axis from line tangent to humeral margins to posterior border (NB, do not confuse pretergite of second segment with posttergite of first, see above).

ASW Width of striae on first gastral tergite calculated by measuring width of a group of striae that cross medial ¼ of width at a point between the petiolar insertion and middisc that is regularly striate (typically halfway between) and dividing by the number of striae in the group.

AW Width of first gastral tergite at widest point measured in dorsal view.

EL Maximum diameter of eye.

HL Head length measured along median axis from line tangent to rearmost points of margin of vertex to anterior clypeal margin on median axis (not to lateral extensions of clypeus).

HW Head width measured across the widest part of the head (not including eyes) in face view just posterior to antennal scrobes.

MeL Length of mesosoma measured from the anterior margin of the pronotum (not including "neck") to the tip of a propodeal spine in dorsal view.

MeW Width of pronotum measured across the widest part of the pronotum in dorsal view.

MFL Metafemur length, anterior or posterior view, measured along longitudinal axis from ventral juncture of femur and trochanter to distal extremity of femur.

MFW Metafemur width, anterior view; perpendicular distance between lines parallel to longitudinal axis used for MFL and tangent to dorsal and ventral borders of femur.

MTL Metatibia length measured along exterior surface, not including basal condyle.

PpW Postpetiole width measured in dorsal view.

PrL Length of dorsal face of propodeum measured along median axis from approximate center of propodeal suture to approximate juncture of dorsal and posterior faces (corresponding to base of imaginary parabola formed by extending inner margins of propodeal spines).

PrS Length of propodeal spines measured along median axis from posterior point of PrL to point perpendicular to tip of longest propodeal spine.

PrT PrL + PrS. PrL and PrS are always measured at the same time, such that the endpoint of PrL is the starting point of PrS. Because of the subjectivity of the posterior margin of the dorsal face of the propodeum, PrL and PrS are somewhat poorly defined, but PrT has more precise anterior and posterior boundaries.

PrW Width of propodeum, dorsal view, across widest part anterior to propodeal spines (including basilateral lobes if present).

PtH Petiole height measured in lateral view perpendicular to line from anterodorsal to posterodorsal margin from summit of dorsal convexity to ventral margin.

PtL Petiole length, in dorsal or lateral view, from anterodorsal to posterodorsal margin.

PtW Petiole width measured in dorsal view across widest point.

SL Scape length from distal end of shaft to lower edge of skirt, which flares over basal condyle and neck.

Collections are referred to by the following acronyms (following the codens listed at the Bishop Museum Web site on insect and spider collections of the world or new codens using the same criteria).

BMNH The Natural History Museum, London, UK
CFFC Fernando Fernandez collection, Instituto Humboldt, Colombia.
CHAH H.A. Hespenheide, personal collection.
CPDC Centro de Pesquisas do Cacau, Itabuna, Bahia, Brazil.
CWEM William and Emma Mackay collection, University of Texas, El Paso, Texas, USA.
FSCA Florida State Collection of Arthropods, Gainesville, Florida, USA.
GBFM Universidad de Panamá, Panamá, Panama.
INBC Instituto Nacional de Biodiversidad, Costa Rica.
LACM Los Angeles County Museum of Natural History, Los Angeles, California, USA.
JTLC John T Longino, personal collection.
MACN Museo Argentino de Ciencias Naturales, Buenos Aires, Argentina.
MCSN Museo Civico de Storia Naturale "Giacomo Doria," Genoa, Italy.
MCZC Museum of Comparative Zoology, Cambridge, Massachusetts, USA.
MHNG Muséum d'Histoire Naturelle, Geneva, Switzerland.
MUCR Museo de Insectos, Universidad de Costa Rica, Costa Rica.
MZSP Museu de Zoologia da Universidade de São Paulo, São Paulo, Brazil.
NHMB Naturhistorisches Museum, Basel, Switzerland.
NMW Naturhistorisches Museum, Vienna, Austria.
PSWC P.S. Ward Collection, University of California, Davis, California, USA.
USNM National Museum of Natural History, Washington, DC, USA.

Kempf (1951) designated lectotypes for many of the Mayr and Forel species of *Procryptocerus*. Examinations of European collections revealed unlabeled or questionably labeled lectotypes and discrepancies that suggested some material was never returned or reincorporated in the collection. Subsequent inquiry to C.R. Brandão regarding the Kempf collection in São Paulo did not resolve the problem, since none of the missing material was found there. In these cases we have relied on the examination of syntypes and tried to clarify the current status of type designations.

Material Examined lists are not always exact transcriptions of specimen labels but are instead extracted from a specimen database (maintained using Biota: Colwell, 1996), in which specimen labels have been interpreted and augmented when possible.

KEY TO *PROCRYPTOCERUS* SPECIES OF CENTRAL AMERICA

The following key is based on workers. In general, key characters pertaining to the head or gaster apply equally to workers and queens.

1a. Sculpture on face composed entirely of high, sharp carinae, which often anastomose to form areolae (Fig. 1A, B), but which may be regularly longitudinally parallel; first gastral tergite smooth, punctate, or striate; if striate, <40 striae/mm across disc; base of scape never flattened 2

b. Sculpture on face composed entirely of discrete, rounded foveae (Fig. 1H–J); distance between foveae ≥ fovea diameter; interspaces generally smooth, minutely areolate; foveae uniformly covering face or restricted to anterior half or less, leaving posterior portion of face smooth; base of scape terete or flattened (see also 1c) 4

c. Sculpture on face striate (Fig. 1D), or a mixture of striae and foveae (Fig. 1D–G), or with shallow more or less confluent foveae (Fig. 1C); if entirely foveate (Fig. 1G), sculpture very shallow and gaster covered with long, flattened, subdecumbent setae; base of scape never flattened 9

2a. First gastral tergite densely micropunctate over most of surface; sculpture on face uniformly areolate with no longitudinal orientation (Fig. 1B), HW < 1.05 mm . . . *P. belti*

b. First gastral tergite usually smooth and shining, occasionally with longitudinal rugulae anteriorly or with longitudinal rugulae both anteriorly and posteriorly; sculpture on face often with at least some longitudinal orientation medially (Fig. 1A); HW > 1.05 . . . 3

3a. Lateral portion of clypeus expanded, such that a trough is formed between it and torulus (Fig. 2A); in anterior view torulus is partially hidden; mesosoma length < 1.9 mm; side of dorsal face of propodeum often with a tooth or lobe midway between base of propodeum and base of propodeal spine . . . . *P. batesi*

b. Lateral portion of clypeus falls perpendicularly to base of torulus (Fig. 2B), such that in anterior view torulus is clearly visible; mesosoma length (ML) usually >1.9 mm; side of dorsal face of propodeum straight with no tooth or lobe midway between base of propodeum and base of propodeal spine . . . . . *P. mayri*

4a. First gastral tergite densely and finely striate over entire surface; erect setae stiff, short, sparse 5

b. First gastral tergite smooth or with striae confined to anterior one half; erect setae thin and flexuous or absent 6

5a. Base of scape flattened, as wide as distal end; HW > 1.20 mm; anterior face of petiole smooth and shining . . . . . *P. kempfi*

b. Base of scape (above basal flange) subterete, narrower than distal end; HW < 1.20 mm; anterior face of petiole with coarse transverse striae . . . . . *P. hylaeus*

6a. Base of scape (above basal flange) subterete, narrower than distal end; scape orange brown or black 7

b. Base of scape flattened, as wide as distal end; scape black 8

7a. Face largely smooth and shining, weak foveae confined to anterior third (Fig. 1I) . . . . . *P. coriarius*

b. Face uniformly foveate (Fig. 1J) . . . . *P. eladio*

8a. First gastral tergite smooth and shiny, with scattered minute puncta, lacking longitudinal sculpture in Central America, with anterior longitudinal rugulae in Peru; mesosomal dorsum with abundant long flexuous setae . . . . *P. nalini*

b. First gastral tergite with anterior portion evenly longitudinally striate; mesosomal dorsum with sparse, short, stiff setae . . . . . *P. attenuatus*

9a. Sculpture on face composed of confluent, very shallow foveae (Fig. 1C); first gastral tergite finely longitudinally striate, with sparse erect short setae; HW < 1.0 mm . . . . *P. pictipes*

b. Sculpture on face striate or very shallow and a mixture of foveae and weak rugulae (Fig. 1D–G); HW > 1.0 mm 10

10a. Dorsal face of propodeum and first gastral tergite with relatively few setae, which are not strongly flattened (Fig. 3A, B); face with conspicuous longitudinal rugae with variable development of small foveae (Fig. 1D); posterior face of forefemur smooth or with faint carinae, which do not extend the full length of femur . . . . . *P. scabrausculus*

b. Dorsal face of propodeum and first gastral tergite with strongly flattened setae (Fig. 3C–F); sculpture on face very shallow, foveae more conspicuous than rugae (Fig. 1E–G) 11

11a. Gaster densely covered with subdecumbent, strongly flattened, glittering setae; along median axis of first gastral tergite decumbent setae overlap by about half their length; lateral lobes of mesonotum in the form of horizontal flanges which are blunt, posteriorly directed, and project over the propodeal suture, such that in side view their vertically concave posteroventral margins obscure the median portion of the suture (Fig. 3F) . . . *P. impressus*

b. Gaster with relatively less dense setae on first gastral tergite; along median axis, decumbent setae overlap by less than half their length or do not overlap; lateral lobes of mesonotum smaller, such that in side view they

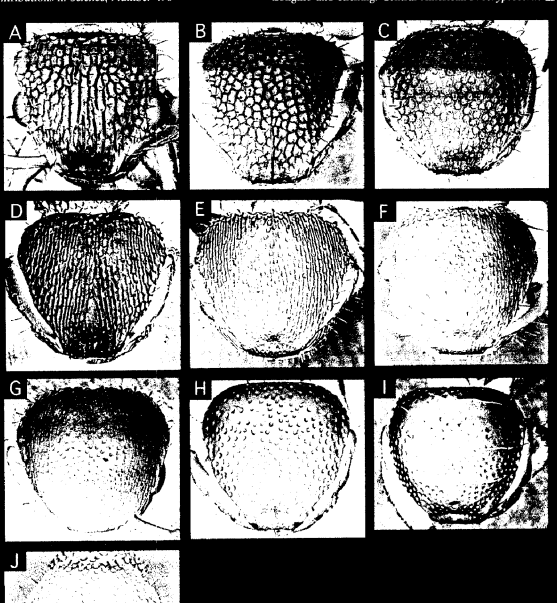

Figure 1 Face view of *Procryptocerus mayri* (A), *P. belti* (B), *P. pictipes* (C), *P. scabriusculus* (D), *P. paleatus* (E), *P. tortuguero* (F), *P. impressus* (G), *P. nalini* (H), *P. coriarius* (I), *P. eladio* (J)

do not obscure the propodeal suture (Fig. 3D) 12

12a. First gastral tergite continuously striate from anterior to posterior border; face nearly or entirely devoid of erect setae (Fig. 1E) . . . . . *P. paleatus*

b. Striae on first gastral tergite fading out before attaining posterior margin; face with about 10 erect setae (Fig. 1F) . . . . . *P. tortuguero*

TAXONOMIC SYNOPSIS OF SPECIES TREATED IN THIS PAPER

P. attenuatus (F. Smith, 1876). Costa Rica to Bolivia, Amazonia

Figure 2 Torulus, clypeus, and frontal carina complex for *Procryptocerus batesi* (left) and *P. mayri* (right)

= *punctic*eps (F. Smith, 1876)
= *guianensis* Weber, 1938.
P. batesi Forel, 1899. Costa Rica, Colombia
= *laeviventris* Forel, 1899. Costa Rica, Panama. **new synonymy**
P. belti Forel, 1899. Mexico to Panama, Ecuador.
P. convexus* Forel, 1904. Brazil (Amazonas, Pará). **new status
P. coriarius (Mayr, 1870). Costa Rica, Colombia.
P. eladio Longino and Snelling. Costa Rica. **new species**
**P. goeldii* Forel, 1899. Southern Brazil, Paraguay.
**P. hirsutus* Emery, 1896. Brazil, Guyana, Trinidad.
P. hylaeus Kempf, 1951. Panama to southern Brazil, Paraguay.
P. impressus Forel, 1899. Costa Rica, Panama. **new status, status revalidated**
P. kempfi Longino and Snelling. Costa Rica, Panama. **new species**
P. mayri Forel, 1899. Costa Rica to Peru, Brazil
= *reichenspergeri* Santschi, 1921. **new synonymy**
P. nalini Longino and Snelling. Costa Rica, Peru. **new species**
P. paleatus Emery, 1896. Costa Rica, Panama.
P. pictipes Emery, 1896. Costa Rica to Bolivia, Brazil
= *parva* Menozzi, 1935.
P. scabriusculus Emery, 1894. Mexico to Venezuela.
**P. schmitti* Forel, 1901. Brazil, Venezuela.
**P. subpilosus* (F. Smith, 1860). Brazil, Ecuador, Guyana, Peru, Trinidad.
P. tortuguero Longino and Snelling. Costa Rica. **new species**

* Species not known from Central America.

SPECIES ACCOUNTS

Procryptocerus attenuatus (F. Smith, 1876)

Meranoplus attenuatus F. Smith, 1876:610, pl. 11, fig. 9. Holotype queen: Brazil, Pará [BMNH] (examined).
Meranoplus puncticeps F. Smith, 1876:610–611, pl. 11, fig. 10. Holotype worker: Brazil, Pará [BMNH] (examined). Synonymy by Forel, 1911:262.
Cataulacus attenuatus: Mayr, 1886:364.
Cataulacus puncticeps: Mayr, 1886:364.
Procryptocerus attenuatus: Emery, 1887:470; Kempf, 1964a:436–437.
Procryptocerus puncticeps: Emery, 1887:470.
Procryptocerus subpilosus attenuatus: Forel, 1911:262; Kempf, 1951:61–62.
Procryptocerus goeldii guianensis Weber, 1938:208. Holotype alate queen: Guyana, Forest Settlement, Mazaruni River (Weber) [MCZC]. Synonymy by Kempf, 1964a:436–437.

RANGE. Brazil (Amapá, Amazonas, Pará, Rondonia, Roraima), Bolivia, Peru, Guyana, Suriname, Panama, Costa Rica.

DESCRIPTION OF WORKER. Worker measurements (n = 1, Panama): HW 1.001 (range 1.001–1.069, n = 3), HL 0.939, SL 0.622, EL 0.257, MeL 1.203, MeW 0.706, PrW 0.539, PrL 0.273, PrS 0.196, PrT 0.469, MTL 0.615, PtL 0.379, PtW 0.349, PpW 0.505, PtH 0.292, AL 1.262, AW 1.073, ASW 0.023.

Head roughly circular in outline; frontal carina ends on the torulus, forming notch ventrally that receives inner basal projection of scape; face to vertex margin with evenly dispersed discrete foveae; interspaces subgranular with fine areolate etchings; clypeus at level of antennal insertions abruptly bent ventrad; upper margin of clypeus and entire clypeal bend longitudinally rugose, 10–12 rugae between antennal insertions; rugae diverge on lower portion

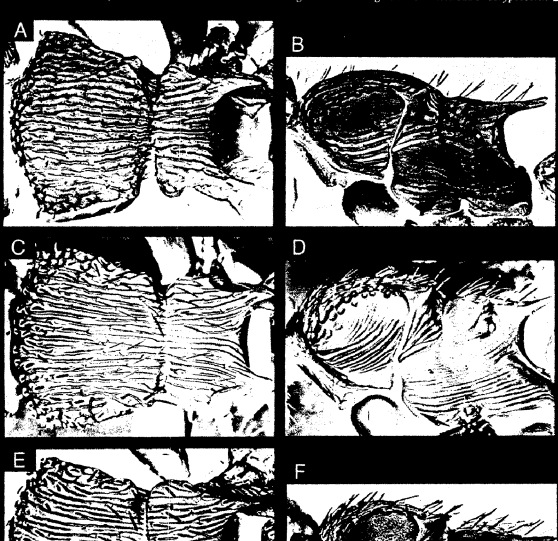

Figure 3 Dorsal and lateral views of mesosoma for *Procryptocerus scabriusculus* (A, B), *P. paleatus* (C, D), and *P. impressus* (E, F)

of clypeus, leaving median unsculptured depression at lower margin; genae with closely spaced foveae; genal bridge longitudinally rugose; mandible with coarse longitudinal striae; in anterior view, eyes asymmetrically convex, skewed ventrad; scape flattened, as wide as or wider at base than at apex, lateral margins thickened, especially at base, such that cross-section roughly hourglass shaped; broad flat surface of scape finely areolate, lateral margin with coarse rugae; margin of vertex angulate but not carinate or crenate; vertex with some coarse striae radiating from the occiput, especially laterally, otherwise smooth and shiny.

In dorsal view, mesonotum with small lateral lobes usually with straight lateral margins parallel to the longitudinal body axis, posteriorly squared-off so that they are hardly toothlike, ending at the anterior margin of the propodeal suture; occasionally subacute and slightly toothlike; propodeal suture a broad, shallow trough; dorsal face of propodeum with anterolateral lobes distinct, evenly convex to subrectangular, with variably developed posterolateral angle; pronotum foveate rugose, rugae becoming somewhat more longitudinally parallel on mesonotum; propodeal suture with regular parallel striae which continue onto dorsal face of

propodeum; posterior face of propodeum perpendicular to dorsal face, slightly concave; usually completely smooth and shining except for one or two transverse striae dorsally, between bases of propodeal spines (one specimen from Peru with longitudinal striae continuing from dorsal face onto posterior face); parallel longitudinal striae cover lateral pronotum, anepisternum, katepisternum, and lateral propodeum; those on pronotum and anepisternum usually larger than those on katepisternum and propodeum; coxae striate; hind femur strongly swollen medially, spindle-shaped; posterior surface of forefemur faintly obliquely striate (of variable strength); remaining femur surfaces smooth.

Ventral margin of petiole concave to nearly flat, ending anteriorly in a variably developed, blunt, right-angled tooth; anterodorsal face of petiole longitudinally striate, irregularly reticulate-rugose, transversely striate, or nearly smooth; posterodorsal face reticulate-rugose; postpetiole with a long, gently sloping anterior face, a broad, rounded summit near the posterior margin, and a steeply sloping posterior face; ventral margin of postpetiole short, with a prominent, acute anterior tooth; anterior face of postpetiole longitudinally striate, posterior face reticulate-rugose; anterior portion of first gastral tergite with largely straight and parallel, occasionally anastomosing striae; striae fade to finely areolate microsculpture and widely dispersed, very small puncta at approximately half AL, areolate microsculpture gradually fades posteriorly (specimens from Rondonia and Peru with somewhat sharper, nonanastomosing striae and generally shinier surface); anterolateral portion of first gastral sternite with fine, longitudinal striae, these fading medially and posteriorly; remainder of sternite smooth and shiny with uniformly distributed, sparse punctа; second gastral tergite nearly smooth medially, with faint, finely areolate microsculpture becoming stronger laterally.

Specimens from Central America and central to eastern Amazonia with 0–4 stiff setae on disc of face; 0.09–0.11 mm long; sparse stiff setae on mesosomal dorsum, to 0.09 mm; stouter setae on petiole and postpetiole, to 0.18 mm; first gastral tergite with 0–4 stiff erect setae, to 0.10 mm long, and sparse, very short, appressed pubescence emanating from puncta; specimens from Rondonia and Peru with setae relatively longer, more abundant, and more flexuous, especially on anterior portion of first gastral tergite; color shining black, with appendages gradually fading to dark brown distally.

DESCRIPTION OF QUEEN. Queen measurements (n = 1, Panama): HW 1.07, HL 1.06, SL 0.62, EL 0.27, MeL 1.53, MeW 0.90, MTL 0.71, AL 1.56, AW 1.18.

Similar to worker in most respects; pronotum, mesoscutum, axillae, and scutellum coarsely foveate, with a few irregular rugae on scutellum and extending onto axillae; propodeum essentially as in worker.

BIOLOGY. This rarely-collected species occurs in the high canopy of lowland rainforest trees. Some collections have come from insecticidal fogging of the canopy (*Luehea seemannii* in Panama, the Erwin fogging program in Peru). Weber (1938) obtained the winged queen of *P. guianensis* from the stomach of *Bufo marinus*. An LACM specimen is a queen head capsule collected from the feces of a silky anteater (*Cyclopes*). The only known nest collection was by W. L. Brown, Jr., from near Manaus. The collection contains a dealate queen and a male.

ADDITIONAL MATERIAL EXAMINED. BOLIVIA: *Beni*: Cachuela Esperanza, 10°32′S, 65°38′W (W.M. Mann) [USNM]. BRAZIL: *Amapá*: Rio Amapari, km 180 (J. Lane) [MZSP]; *Amazonas*: Aleixo, nr Manaus, 3°07′S, 60°02′W (W.L. Brown, Jr.) [LACM, MCZC]; Manaus, 3°07′S, 60°02′W (K. Lenko) [MZSP]; *Pará*: Ald. Araçu, Igar. Urupi-Una (B. Malkin) [MZSP]; *Rondonia*: Vilhena, 12°43′S, 60°07′W (M. Alvarenga) [MZSP]; *Roraima*: Ilha de Maracá, 3°25′S, 61°40′W (EP. Benton) [CPDC]. COSTA RICA: *Limon*: Tortuguero N.P., Est. Cuatro Esquinas, 10°35′N, 83°31′W, <10 m (Solano) [MZSP]; *Puntarenas*: Estación Bijagual, 500 m (Saborio) [INBC]; Rancho Quemado, 200 m (Quesada and Varela) [INBC]. GUYANA: New River, 3°23′N, 57°36′W (J. Myers) [MCZC]. PANAMA: *Canal Zone*: Pipeline Road (Montgomery and Lubin) [LACM]; same locality (Y.D. Lubin) [LACM]; Ruta 1, 14 km W Panama City, 8°57′N, 79°33′W, 200 m (canopy fogging team) [MCZC]; vic. Punta de los Chivos, 9°14′N, 79°56′W (canopy fogging team) [MCZC]. PERU: *Madre de Dios*: Tambopata, 12°50′S, 69°20′W, 290 m (T.L. Erwin) [LACM]. SURINAME: Surinam River, Sara Creek, Adjamakandre, 4°49′N, 55°00′W (D.C. Geijskes) [USNM].

Procryptocerus batesi Forel, 1899

Fig. 2

Procryptocerus batesi Forel 1899:43. Lectotype worker: Colombia (Landolt) [MHNG] (examined). Kempf 1951:22–24, fig. 22 (lectotype designation and redescription of worker).

Procryptocerus carbonarius var. *laeviventris* Forel, 1899: 47. Holotype worker: Panama, Volcán de Chiriquí (Champion) [MHNG] (examined). **new synonymy**

Procryptocerus carbonarius (part): Kempf, 1951:27. Incorrect synonymy of *P. laeviventris* under *P. carbonarius*.

RANGE. Costa Rica, Panama, Colombia.

DESCRIPTION OF WORKER. Worker measurements (n = 1, Costa Rica): HW 1.281 (range 1.111–1.502, mean 1.28, n = 5), HL 1.266, SL 0.846, EL 0.329, MeL 1.709, MeW 0.986, PrW 0.651, PrL 0.424, PrS 0.33, PrT 0.758, MTL 0.966, MFL 1.074, MFW 0.365, PtL 0.462, PtW 0.420, PpW 0.529, PtH 0.364, AL 1.641, AW 1.360.

Head subtriangular in outline, margin of vertex roughly straight; frontal carina extends onto clypeus, separated from and passing above torulus as a continuous flange; clypeus produced anteriorly and torulus recessed, with distinct trough anterior to torulus; face to margin of vertex with widely spaced sharp rugae, which form areolae over entire surface or at least peripherally and with various degrees of

longitudinal orientation medially; clypeus at level of antennal insertions abruptly bent ventrad; clypeus with prominent median longitudinal carina, flanked with 3–4 longitudinal carinae on each side; lateral carinae of variable strength; genae varying from longitudinally rugose to coarsely foveate/areolate; genal bridge longitudinally striate; mandible with coarse longitudinal stria; eyes nearly symmetrically convex; scape flattened with thick lateral margin distally, becoming narrower and more terete basally, then flaring into a basal flange; broad flat surface of scape finely areolate, outer lateral margin with coarse rugae; margin of vertex obtuse, weak, obsolete medially; vertex shiny with coarse, longitudinal striae radiating from occiput (of highly variable strength).

Mesonotal lobes short, acute, upturned; propodeal suture broadly, shallowly impressed, not breaking sculpture; anterolateral propodeal lobes obsolete or with indistinct, small obtuse teeth a short distance posterior to anterolateral margin; pronotum reticulate rugose, coarsely areolate anteriorly; in some specimens rugae somewhat longitudinally parallel on mesonotum; dorsal face of propodeum reticulate rugose to longitudinally striate, with 8–10 striae; posterior face of propodeum meeting dorsal face at obtuse angle; posterior face of propodeum completely smooth and shining on ventral one half or more; one or two transverse striae dorsally, between bases of propodeal spines, or longitudinal striae extend a short distance onto posterior face; dorsal half of side of pronotum coarsely areolate-foveate; ventral half with 4–5 coarse longitudinal striae or reticulate rugose; anepisternum areolate-foveate or with 2–3 coarse longitudinal striae; katepisternum with ≤8 longitudinal striae, these smaller than or the same size as striae on lateral pronotum, or katepisternum reticulate rugose; when katepisternum striate, striae extend onto lateral propodeum; these propodeal striae degrade into reticulate rugosity posteriorly; posterior surface of forefemur entirely smooth and shining; outer surface of metatibia coarsely rugose.

Ventral margin of petiole flat, with anterior ventrally projecting right-angled tooth; anterodorsal face of petiole shiny with coarse to faint transverse striae (completely smooth in a few specimens); posterodorsal face areolate-foveate (weakly longitudinally rugose in some specimens); postpetiole with a long, gently sloping anterior face, a broad, rounded summit near the posterior margin, and a steeply sloping posterior face; ventral margin of postpetiole short, with a prominent, acute anterior tooth; dorsum of postpetiole coarsely foveate-rugose (weakly longitudinally rugose in some specimens); first gastral tergite completely smooth or with varying expression of irregular longitudinal striae (in Costa Rica, specimens from the Cordilleras de Guanacaste and Tilarán and the Atlantic slope of the Cordillera Central usually lack striae on the first gastral tergite; some collections from the Cordillera Central and a collection from the Cordillera de Talamanca have striae on the anterior portion; a specimen from the Osa Peninsula has striae on both anterior and posterior portions, with the disc smooth; a specimen from Estación Carrillo, on the north slope of the Cordillera Central, has the entire surface striatopunctate); microsculpture composed of hexagonal plates, these ranging from distinctly visible to completely effaced; hexagonal plates flat; first gastral sternite largely microreticulate, nearly smooth; second gastral tergite with faint, dense, granular sculpture.

Abundant flexuous setae on face, mesosomal dorsum (>20 on central area of promesonotum, not including those on lateral margins), petiole and postpetiole, and gaster; color shining black, with appendages gradually fading to dark brown distally.

DESCRIPTION OF QUEEN. The queen, previously unknown, is described based on a dealate queen from Monteverde, Costa Rica. Queen measurements (n = 1, Costa Rica): HW 1.45, HL 1.37, SL 0.89, EL 0.35, MeL 2.13, MeW 1.26, MTL 1.09, PtL 0.56, PtW 0.46, PpW 0.64, PtH 0.42, AL 1.85, AW 1.62.

Head subtriangular in dorsal view, margin of vertex somewhat erose, well-defined laterally, obscure medially, such that the margin appears cordate. In lateral view, scrobe extends straight back almost to vertex margin, then abruptly bends ventrally. Vertex shiny, with approximately 20 carinae radiating from occipital foramen. Interior of scrobe shiny. Frons coarsely areolate, as in worker. Clypeus sharply bent in the middle, such that the anterior half is perpendicular to the frons. Clypeus with approximately eight sharp longitudinal carinae, which diverge anterior to the bend, leaving a deep anteromedian depression with transverse rugae and a dense tuft of golden setae. Genae similar to frons, genal bridge longitudinally striate. Mandibles with basal and masticatory margins meeting at a sharp right angle, apex of masticatory margin with three teeth of progressively smaller size, followed by two small denticles, lower half of masticatory margin completely edentate, flat. Outer surface of mandibles longitudinally striate. Scape with enlarged basal tooth extending down over neck and condyle, lower shaft subterete, becoming broader and flattened distally. Scape minutely alveolate, with outer margin faintly rugose.

Pronotum, axillae, scutellum, and dorsal face of propodeum coarsely areolate as on frons, mesoscutum tending more to discrete foveae. Posterior face of propodeum smooth and shiny except for 1–2 transverse carinae between spine bases. Sides of pronotum grading into coarse longitudinal striae. Similar striae covering dorsal half of katepisternum, extending about halfway across the propodeum; rest of sides of mesosoma, including anepisternum, coarsely areolate. Forecoxae transversely striate, meso- and metacoxae unsculptured. Propodeal spines triangular, just under half the length of the dorsal face of the propodeum. Femora strongly

swollen medially, spindle-shaped. Exterior surfaces of tibiae longitudinally rugose-areolate, rest of legs smooth and shining.

Petiole elongate with gently convex dorsal surface, ventral surface concave, with small anterior tooth. Postpetiole with short, stout anteroventral tooth. Anterior face of petiole shiny with a few transverse striae. Posterior face of petiole and dorsum of postpetiole coarsely areolate; gaster completely unsculptured except for sparse, minute piligerous puncta, and very narrow traces of rugae at the margins of terga and sterna.

Body and appendages completely covered with short, filiform setae; first gastral tergite also with sparse, very short subdecumbent setae; color uniformly black.

COMMENTS. In the mountains of southern Central America and South America, a complex of species occurs that have (1) the frontal carinae separate from the torulus, passing above it and onto the clypeus; (2) the face sculpture varying from completely striate to strongly clathrate (composed of high, sharp, well-separated rugae, which form irregular polygons over face surface); and (3) the first gastral tergite varying from striate to completely smooth and shining. The complex occurs as a series of allopatric populations restricted to montane forests. There is abundant material from Costa Rica, which reveals the presence of two sympatric species. The populations in Costa Rica and western Panama are peripheral isolates, with the nearest neighbors being populations in the Colombian Andes. Collections occur from Venezuela, through Colombia and Ecuador, south to Peru, but they are too few to draw conclusions about communities of sympatric species or the nature of character variation. Character variation is high even within Costa Rica, and discordant character variation occurs across the material from South America. Each local mountain range may host a unique community, shaped by a combination of dispersal history, local selection, and perhaps hybridization. As a result, a clear taxonomy of these forms may be elusive.

A discrete character that separates sympatric forms in Costa Rica is the presence or absence of a torulus trough. The torulus trough is an effect of the shape of the lateral portion of the clypeus. In specimens lacking a trough, the lateral portion of the clypeus falls perpendicularly to the torulus, such that in anterior view (looking at the head with mandibles forward) the torulus is relatively exposed. In specimens with a trough, the lateral clypeus is somewhat produced, such that it falls to the torulus at an acute angle, and in anterior view, the torulus is relatively obscured by the lateral "wings" of the clypeus. South American material exhibits a full range of states for this character, from no torulus trough to a deep, pronounced one.

Current available names in this complex are *P. carbonarius* Mayr, 1870, from Colombia; *P. rudis* Mayr, 1870, from Colombia; *P. batesi* Forel, 1899, from Colombia; *P. laeviventris* Forel, 1899, from Panama; *P. mayri* Forel, 1899, from Colombia; *P. reichenspergeri* Santschi, 1921, from Brazil; and *P. virgatus* Kempf, 1964, from Ecuador. Kempf synonymized *P. laeviventris* under *P. carbonarius*; the rest are currently valid. The type of *P. laeviventris*, from western Panama, clearly falls within the Central American group with the torulus trough. In Colombia, species boundaries are unclear, but we have examined the types of *P. rudis*, *P. batesi*, and *P. carbonarius*. All three of them have a torulus trough, but they vary in gastral sculpture and body size. The type of *P. laeviventris* most closely matches *P. batesi*, not *P. carbonarius*. Therefore, we have transferred it from *P. carbonarius* to *P. batesi* and identify as *P. batesi* the Central American material with a torulus trough. The types of *P. mayri* and *P. reichenspergeri* match the Central American species that lacks a torulus trough. *Procryptocerus virgatus*, from Ecuador, has a weak torulus trough. It and other material from Ecuador and southern Colombia exhibit variation in the torulus trough that blurs the distinct character states found in Central America.

BIOLOGY. Most collections are of foraging workers obtained from montane wet forest on low vegetation or in the canopy. No collections are known from below 600 m elevation. Workers are often observed in recent treefalls. *Procryptocerus batesi* appears to be very similar to *P. mayri* in its habitat preference and nesting habits (see additional notes under *P. mayri*). Nests contain fewer than 100 workers and may be found in live or dead stems. Colonies appear to be monogynous. Polydomy probably occurs because queenless nests can be found. The following data on nest collections are extracted from field notes, all from Costa Rica.

Longino, 23–24 Jul 1984, Río Peñas Blancas. An entire nest was collected in a hollow, living stem of an epiphytic shrub, 20 m high in a *Guarea* tree. The nest contained 55 adult workers, 1 dealate queen, 1 adult male, 3 pupae, 13 large larvae, and a small amount of smaller brood.

Longino #1601, Casa Eladio, Río Peñas Blancas. An entire nest was collected from one internode of a *Cecropia insignis* sapling. The nest contained 87 adult workers, 58 pupae, 10 prepupae, 18 large larvae, and a few small larvae and eggs.

Longino #2356, Cerro Cacao. An entire nest was collected from a dead branch. The nest contained 96 workers, 1 dealate queen, and brood.

ADDITIONAL MATERIAL EXAMINED. COSTA RICA: La Fuente (A. Alfaro) [MCSN]; *Alajuela*: Peñas Blancas Valley, 10°18'N, 84°42'W, 940 m (J. Longino) [FSCA, LACM, MCZC, MZSP]; Casa Eladio, Río Peñas Blancas, 10°19'N, 84°43'W, 800 m (J. Longino) [JTLC, LACM]; El Aleman, Río Peñas Blancas, 10°18'N, 84°45'W, 940 m (J. Longino) [LACM]; 4 km N Vara Blanca, 10°12'N, 84°10'W, 1350 m (H. Hespenheide) [LACM]; Rio San Lorencito, 5 km N Col. Palmarena, 10°17'N, 84°34'W, 900 m (INBio curso Carabidae) [INBC]; *Cartago*: 8 km ESE Moravia, 9°48'N, 83°23'W, 700 m (J. Longino) [LACM]; *Guanacaste*: W side Volcán

Cacao, 10°56'N, 85°27'W, 1100 m (I. Gauld) [MUCR]; Casa Mengo, Volcán Cacao, Guanacaste Cons. Area, 10°56'N, 85°27'W, 1100 m (R. Blanco and C. Chaves) [INBC]; Cerro Cacao, 10°56'N, 85°28'W, 1500 m (J. Longino) [JTLC, LACM]; 3 km N Santa Elena, 10°20'N, 84°50'W, 1500 m (J. Longino) [LACM]; Arenales, W side Volcán Cacao, 10°56'N, 85°28'W, 900 m (unknown) [MUCR]; *Heredia:* Casa Plastico, 17 km S Pto. Viejo, 10°18'N, 84°02'W, 550 m (J. Longino) [LACM]; 12 km N Vol. Barba, 10°15'N, 84°05'W, 1400 m (J. Longino) [LACM]; 16 km N Vol. Barba, 10°17'N, 84°05'W, 950 m (J. Longino) [JTLC, LACM]; *Puntarenas:* 3 km SSE Monteverde, 10°17'N, 84°48'W, 1100 m (S. Koptur) [LACM]; same data (J. Longino) [JTLC, LACM]; Cerro Rincon, Corcovado National Park, 8°33'N, 83°29'W, 700 m (J. Longino) [JTLC, LACM]; Monteverde, 10°18'N, 84°48'W, 1500 m (P.S. Ward) [PSWC]; same data (J. Longino) [LACM]; same data (J.H. Hunt) [LACM]; same data, 1400 m (J. Longino) [JTLC, LACM]; below Sticky Farm, Monteverde, 10°17'N, 84°49'W, 1100 m (S.P. Cover) [LACM]; 6 km SW Monteverde, 10°18'N, 84°49'W, 1350 m (S. Koptur) [LACM]; Monteverde, 10°18'N, 84°48'W, 1600 m (J. Longino) [LACM]; Wilson Botanical Garden, 4 km S San Vito, 8°47'N, 82°58'W, 1200 m (D.H. Janzen) [LACM]; same data (P.S. Ward) [JTLC]; Bajo Tigre, Monteverde, 10°18'N, 84°49'W, 1200 m (J. Longino) [LACM]; Cerro Plano de Monteverde, 10°18'N, 84°49'W, 1300 m (P.S. Ward) [PSWC]; 6 km WNW Las Alturas, 8°58'N, 82°53'W, 1650 m (P.S. Ward) [LACM]; Cerro Rincon, 8°33'N, 83°29'W, 745 m (P. Hanson) [MUCR]; Estacion Biol. Pittier, 9°02'N, 82°58'W, 1670 m (J. Longino) [JTLC, INBC, LACM]; Fila Cruces, nr San Vito, 8°47'N, 83°03'W, 1200 m (J. Longino) [LACM]; Monteverde, 10°18'N, 84°48'W, 1400 m (H. Hespenheide) [LACM]; same data (E.M. Fisher) [LACM]; same data (S. Koptur) [LACM]; same data (J. Longino) [JTLC, LACM]; *San José:* Bajo La Hondura, Braulio Carrillo Nat. Park, 10°04'N, 83°59'W, 1100 m (J. Longino) [LACM]; same data (P.S. Ward) [PSWC]; 9.5 km E tunel, Braulio Carrillo Nat. Park, 10°07'N, 83°58'W, 1000 m (P. Hanson) [MUCR]; Estación Carrillo, Braulio Carrillo Nat. Park, 700 m (Curso Hymenoptera, INBio) [INBC]. PANAMA: *Panamá:* Cerro Campana, 8°40'N, 79°56'W, 850 m (H. Hespenheide) [JTLC, LACM].

Procryptocerus belti Forel, 1899

Fig. 1B

Procryptocerus belti Forel, 1899:46, pl. 3, fig. 6. Lectotype worker, two paralectotype queens, one paralectotype male: Costa Rica, Nicoya (Alfaro) [MHNG] (queens and male examined); paralectotype workers, queens, males: same data [MCSN] (examined, one worker here designated neolectotype].

Procryptocerus belti: Kempf, 1951:31–33, fig. 24, 39, 55 (redescription of all castes).

RANGE. Mexico to Panama, Ecuador.

DESCRIPTION OF WORKER. Worker measurements (n = 1, Costa Rica): HW 0.991 (range 0.88–0.99, mean 0.93, n = 12), HL 0.976, SL 0.645, EL 0.280, MeL 1.166, MeW 0.686, PrW 0.478, PrL 0.241, PrS 0.241, PrT 0.483, MTL 0.626, PrL 0.331, PtW 0.302, PpW 0.419, PtH 0.316, AL 1.179, AW 1.034.

Head subtriangular in outline, margin of vertex approximately straight; face with uniform areolate sculpture; frontal carina extends onto clypeus; separated from and passing above torulus as a differentiated carina; face to margin of vertex with regular honeycomblike areolate sculpture; clypeus at level of antennal insertions abruptly bent ventrad; clypeus with prominent median carina, very faint longitudinal striae laterally; genae with closely spaced foveae; genal bridge longitudinally striate; mandible granular, subopaque, with weak longitudinal striae; in anterior view, eyes asymmetrically convex, skewed ventrad; scape flattened with thick lateral margin distally, becoming narrower and more terete basally, then flaring into a basal flange; broad flat surface of scape finely areolate, outer lateral margin with coarse rugae; margin of vertex angulate but smooth, not crestlike or crenate; vertex largely smooth and shiny, with a few faint striae radiating from occiput.

Mesonotum convex, forming continuous curve with pronotum; in dorsal view, lateral lobes of mesonotum obsolete, visible at other angles as short, obtuse teeth; propodeal suture a broad, shallow trough; anterolateral propodeal lobes indistinct, small obtuse teeth a short distance posterior to anterolateral margin; promesonotum coarsely foveate anteriorly, becoming reticulate rugose on mesonotum (a specimen from Bugaba, Panama, with posterior half of the mesonotum longitudinally rugose, thus approaching *birsutus,* but otherwise similar to typical Central American *belti*); irregular parallel longitudinal striae on dorsal face of propodeum, approximately 10 striae across at level of lateral lobes; posterior face of propodeum perpendicular to dorsal face, posterior face flat; posterior face of propodeum completely smooth and shining; parallel longitudinal striae cover lateral pronotum, anepisternum, katepisternum, and lateral propodeum; approximately six irregular striae on lateral pronotum, grading into foveae dorsally, and one or two on anepisternum, of similar size to those on pronotum; approximately eight striae extend unbroken across katepisternum and lateral propodeum, these contrastingly smaller; posterior surface of forefemur entirely smooth and shining; outer surface of metatibia granular, with a few very faint rugae.

Ventral margin of petiole weakly concave, ending anteriorly in very small, obtuse tooth; anterodorsal face of petiole smooth and shiny; posterodorsal face coarsely foveate-rugose; postpetiole with flat anterodorsal face, short sloping posterior face; ventral margin of postpetiole short, with a prominent, acute anterior tooth; dorsum of postpetiole coarsely foveate-rugose; first gastral tergite densely and finely punctate throughout; first gastral sternite densely and finely punctate laterally and anteriorly, punctation fainter on disc; second gastral tergite with faint, dense, granular sculpture.

Short stiff setae (>100) distributed uniformly on face; abundant stiff setae on mesosomal dorsum (>20 on central area of promesonotum, not including those on lateral margins), longer than those on face; setae on petiole and postpetiole abundant, longer than those on mesosomal dorsum; first gas-

tral tergite with dense, long stiff setae, grading continuously from suberect to decumbent; color shining black, with legs and antennae contrastingly light orange-brown.

DESCRIPTION OF QUEEN. Queen measurements (n = 1, Costa Rica): HW 0.92, HL 0.90, SL 0.60, EL 0.27, MeL 1.34, MeW 0.75, MTL 0.59, PtL 0.34, PtW 0.29, PpW 0.43, PrH 0.30, AL 1.14, AW 1.05.

Similar to worker in most respects; pronotum, mesoscutum, axillae, and scutellum coarsely foveate and covered with a dense stubble of stiff, erect setae; foveae of mesoscutum somewhat elongate; dorsal face of propodeum longitudinally striate.

One of the two paralectotype queens at MCSN is aberrant. Unlike typical *P. belti* workers and queens, this queen has greatly reduced erect setae on the gaster. The queen is typical in all other respects. A queen collected from a treefall in Corcovado National Park, Costa Rica, is similarly aberrant, with greatly reduced setae on both the gaster and the mesosoma. This queen was collected along with absolutely typical workers.

COMMENTS. Kempf (1951:31) examined and described a syntype worker from MHNG and designated it lectotype. There are only one male and two alate queens from the Nicoya series at MHNG (Kempf designated these paratypes, without examination). The specimen examined by Kempf is not at MZSP and is apparently missing. The original Nicoya series originated from Emery's collection [MCSN], where there still reside two workers, three males, and two queens.

Procryptocerus belti is very similar to *P. hirsutus*. *Procryptocerus hirsutus* occurs in lowland Amazonia, the Guyanas, and Trinidad and is either parapatric or allopatric with *P. belti*. *Procryptocerus hirsutus* is larger (HW 1.0–1.3 mm [n = 7] for *P. hirsutus* versus 0.88–0.99 mm [mean = 0.93, n = 12] for *P. belti*). The mesonotum is longitudinally rugose in *P. hirsutus*, reticulate rugose in *P. belti* (with the exception of a specimen from Bugaba, Panama). The outer surface of the metatibia is coarsely rugose in *P. hirsutus*, relatively smooth in *P. belti*. The first gastral tergite is always uniformly punctate in *P. belti*, but in *P. hirsutus* it is variable, ranging from densely punctate to nearly smooth.

See *P. pictipes* for a discussion of character variation and possible phylogenetic relationships among *P. belti*, *P. hirsutus*, *P. convexus*, and *P. pictipes*.

BIOLOGY. *Procryptocerus belti* has been collected in both canopy and understory of primary rainforest, in second growth vegetation, in beach-edge vegetation, and in mangroves. Most collections are of foraging workers from low vegetation, but four nest series were collected from narrow-gauge dead stems, at least one of which was detached and lodged in low vegetation. Collections have been made in the canopies of tall trees, including *Brosimum*, *Sloanea*, *Ficus*, and *Leubea*.

Specimens have been found in the feces of *Cyclopes* (silky anteater).

In Costa Rica, this species prefers seasonally dry habitats. It is very abundant in the lowlands of the Pacific side, south of Puntarenas, but is rare elsewhere. At La Selva Biological Station, in the wet Atlantic lowlands, it is a very rare element of the ant fauna, occurring sparsely in the tops of canopy trees.

ADDITIONAL MATERIAL EXAMINED. COSTA RICA: *Heredia*: La Selva Biological Station, 10°26'N, 84°01'W, 50 m (multiple collections by H. Hespenheide, J. Longino, Project ALAS) [INBC, JTLC, LACM]; *Limón*: 7 km SW Brito, 9°36'N, 82°52'W, 50 m (P. Hanson) [MUCR]; *Puntarenas*: Sirena, Corcovado National Park, 8°29'N, 83°36'W, <50 m (J. Longino) [FSCA, JTLC, LACM]; Bijagual, Carara Biol. Reserve, 9°47'N, 84°36'W, 500 m (J. Longino) [JTLC, LACM, MUCR]; same data (P.S. Ward) [PSWC]; same data (R. Zuñiga) [INBC]; Manuel Antonio Nat. Park, 9°23'N, 84°09'W, 20 m (J. Longino) [JTLC, LACM, MUCR]; same data (P.S. Ward) [PSWC]; Golfo Dulce, 3 km SW Rincon, 8°42'N, 83°29'W, 10 m (P. Hanson) [MUCR]; 19 km S Ciudad Neily, 8°29'N, 82°58'W, 20 m (J. Longino) [JTLC]. ECUADOR: *Los Rios*: Rio Palenque, 2 km SSE Patricia Pilar, 0°35'S, 79°22'W, 160 m (P.S. Ward) [JTLC]. HONDURAS: *Atlántida*: La Ceiba, 15°47'N, 86°48'W (W.M. Mann) [USNM]. MEXICO: *Quintana Roo*: Res. Ecol. San Felipe Bacalar, 40 m, NNW Chetumal, 18°45'N, 88°23'W (A. Rodriguez) [LACM]. NICARAGUA: Isla de Diamante (J.P. Caldwell) [CPDC]. PANAMA: *Canal Zone*: Ruta 1, 14 km W Panama City, 8°57'N, 79°33'W, 200 m (W.L. Brown) [MCZC]; Pipeline Road (Montgomery and Lubin) [LACM]; Barro Colorado Island, 9°09'N, 79°51'W, 100 m (W.M. Wheeler) [MCZC]; same data (H.A. Hespenheide) [LACM]; same data (D.E. Wheeler) [MCZC]; Mt. Hope, nr. Colón, 9°20'N, 79°54'W (W.M. Wheeler) [MCZC]; Marajal, nr. Colón, 9°22'N, 79°54'W (W.M. Wheeler) [MCZC]; Monte Lirio, 9°14'N, 79°15'W (W.M. Wheeler) [MCZC]; Colón, 9°22'N, 79°54'W (E. Adams) [LACM]; Parque Metropolitano, Ciudad de Panama, 8°57'N, 79°33'W (canopy fogging team) [MCZC]; vic. Punta de los Chivos, 9°14'N, 79°56'W (canopy fogging team) [MCZC]; *Chiriquí*: Chiriqui, 8°24'N, 82°19'W (F.M. Gaige) [LACM]; Bugaba, 8°29'N, 82°37'W (Champion) [MHNG].

Procryptocerus convexus Forel, 1904, new status

Procryptocerus hirsutus race *convexus* Forel, 1904:34–35. Holotype worker: Brazil, state of Para (Goldi) [MHNG] (examined). Kempf, 1951:35–36.

RANGE. Brazil (Amazonas, Pará).

DESCRIPTION OF WORKER. The following description is based on brief notes made while examining the type at MHNG. A full description is not available.

HW = 0.97; sculpture on face like *P. belti*, but foveae are larger, shallower; pronotum longitudinally striate with an anterior row of foveae; mesonotum like *P. hirsutus*, longitudinally striate and flat, contrasting with the convex pronotum; dorsal face of propodeum, posterior face of petiole, and dorsum of postpetiole longitudinally striate; first

gastral tergite smooth and shining, with an even, faint areolate pattern; posterior face of forefemur smooth; external face of tibiae weakly rugose; setae on head like *P. belti*, those on mesosoma, petiole, and postpetiole stiff and longer, about two times the length of those on head; setae on first gastral tergite short, relatively sparse, clustered near the postpetiolar insertion and very sparse on the posterior half, with no underlying pubescence; scapes and foretibiae orange, mesotibiae darker, metatibiae dark brown.

A series of workers collected by J. Adis from photoeclectors match the above description exactly.

COMMENTS. A brief examination of the type revealed *P. convexus* to be far more distinct from *P. hirsutus* than the latter was from *P. belti* (see discussion under *P. belti*). *Procryptocerus convexus* seems to be a transition form between *P. belti/hirsutus* and *P. pictipes*. See additional discussion under *P. pictipes*.

ADDITIONAL MATERIAL EXAMINED. BRAZIL: *Amazonas*: Ilha de Curari, 3°15'S, 59°49'W (J. Adis) [LACM].

Procryptocerus coriarius (Mayr, 1870)

Fig. 11

Cataulacus coriarius Mayr, 1870:414. Holotype worker: Colombia, Bogotá, "S. Fé" (Lindig) [NMW] (examined).

Procryptocerus coriarius: Emery, 1887:470; Kempf, 1951: 36–39, fig. 4, 25, 54, 69, 93 (description of type worker, nontype queen).

RANGE. Colombia, Costa Rica.

DESCRIPTION OF WORKER. Worker measurements (n = 1, Costa Rica): HW 0.929, HL 0.920, SL 0.577, EL 0.236, MeL 1.073, MeW 0.652, PrW 0.545, PrL 0.283, PrS 0.123, PrT 0.405, MTL 0.577, MFL 0.634, MFW 0.236, PtL 0.338, PtW 0.311, PpW 0.443, PtH 0.307, AL 1.094, AW 0.982.

Head roughly circular in outline; frontal carina ending on and fused with dorsal torulus, thickened where it approaches torulus; face to vertex margin with widely dispersed small foveae, densest on anterior third of face, absent from posteromedial face; interspaces subgranular with fine areolate etchings; clypeus at level of antennal insertions evenly curved ventrad, with small pair of broadly obtuse teeth projecting outward from anterior margin; clypeus with fine areolate microsculpture and faint longitudinal rugulae; genae with areolate microsculpture and sparse small foveae; genal bridge longitudinally striate; mandible mat, with feeble longitudinal striae; in anterior view, eyes asymmetrically convex, skewed ventrad; scape somewhat flattened distally, becoming more terete basally, basal flange moderately developed; margin of vertex smoothly rounded, not carinate or crenate; vertex smooth and shiny.

Lateral lobes of mesonotum indistinct, at most broadly obtuse angles; propodeal suture a broad, shallow trough, visible as a depression in profile; dorsal face of propodeum with anterolateral lobes distinct; promesonotum coarsely and closely foveate; propodeal suture with regular parallel striae, which continue onto dorsal face of propodeum, dorsal face of propodeum with variable combination of foveae and longitudinal striae; posterior face of propodeum perpendicular to dorsal face, slightly concave, largely smooth and shining; pronotal dorsum rounds onto lateral face, lateral face with row of foveae dorsally, coarse parallel striae ventrally; anepisternum, katepisternum, and lateral propodeum vary from largely smooth and shining to longitudinally striate; coxae smooth; hind femur strongly swollen medially, spindle-shaped; posterior surface of forefemur smooth; outer surface of metatibia feebly rugose.

Ventral margin of petiole flat, ending anteriorly in a small, indistinct right-angled tooth; anterodorsal face of petiole differentiated from longer posterodorsal face, meeting at broadly obtuse angle; anterior face smooth and shining; posterior face coarsely reticulate rugose; ventral margin of postpetiole short, with a prominent, acute anterior tooth; postpetiolar dorsum shallowly convex, without distinct anterior and posterior faces; surface coarsely reticulate rugose; anterior third to half of first gastral tergite with feeble irregular longitudinal rugae with interspersed puncta, this sculpture fading to nearly smooth and shiny posteriorly (Weber series from Medellín with this sculpture nearly effaced, largely smooth and shiny); anterolateral portion of first gastral sternite with a few oblique rugulae, remainder smooth with uniform cover of sparse, small puncta; second gastral tergite smooth or with areolate microsculpture.

Disc of face with 1–2 erect setae; promesonotum with moderately abundant short flexuous setae; setae longer, denser, subdecumbent on dorsal face of propodeum, petiole, and postpetiole; first gastral tergite with cluster of longer, flexuous setae near postpetiolar insertion, grading to a variably developed dense subdecumbent pubescence posteriorly; color shining black, scapes orange, flagellum and legs varying from brown to orange.

DESCRIPTION OF QUEEN. Queen measurements (n = 1, Colombia): HW 0.931, HL 0.912, SL 0.600, EL 0.330, MeL 1.500, MeW 0.827, MTL 0.619, MFL 0.676, MFW 0.231, PtL 0.406, PtW 0.321, PpW 0.457, PtH 0.308, AL 1.405, AW 1.045.

Similar to worker in most respects; foveae more extensive on face relative to worker, but still weakening medially, reduced to small scattered puncta around ocellar triangle; pronotum, mesoscutum, axillae, and scutellum foveate; interspaces subequal to or greater than fovea diameter, with microareolate sculpture; dorsal face of propodeum irregularly rugose-foveate.

COMMENTS. *Procryptocerus coriarius* and *P. schmitti* are extremely similar, the only known differences being the more deeply impressed propodeal suture and the shallower, more sparse foveae

on the face of *P. coriarius* (Kempf, 1951). *Procryptocerus coriarius* has the face largely smooth and shining, with faint foveae confined to the anterior one third. *Procryptocerus schmitti* has the face uniformly foveate. The type of *P. coriarius*, from Bogotá, is somewhat intermediate. Although most similar to the other material identified as *P. coriarius* here, the foveae on the face are stronger and extend further onto the disc.

Procryptocerus coriarius and *P. schmitti* have a parapatric or allopatric distribution. *Procryptocerus coriarius* occurs from Costa Rica to Colombia. *Procryptocerus schmitti* occurs in Venezuela and the northeastern states of Brazil, south to Bahia (see under *P. schmitti*).

BIOLOGY. This is a very rarely encountered species. One Colombian collection was found nesting in withered branches of coffee shrubs (Kempf, 1951). The Costa Rican collection from Guayabo is a dealate queen. The collection from Carrillo was from rainforest, a single worker from low vegetation. Weber's Medellin collection is a nest series with a queen and a male.

ADDITIONAL MATERIAL EXAMINED. COLOMBIA: *Antioquia*: Medellin, 6°15'N, 75°35'W, 1800 m (N.W. Weber) [MCZC]; *Cundinamarca*: La Esperanza, 1250 m (Rene P. Roba) [USNM]; COSTA RICA: *Cartago*: Monumento Nacional Guayabo, A.C. Amistad, 1100 m (G. Fonseca) [INBC]; *San José*: Carrillo, Braulio Carrillo Nat. Park, 10°09'N, 83°57'W, 600 m (J. Longino) [JTLC].

Procryptocerus eladio Longino and Snelling new species

Fig. 1J

HOLOTYPE WORKER. Costa Rica, Prov. Alajuela: Rio Peñas Blancas, 10°19'N 84°43'W, 800 m, 25 Jun 1991 (Longino #2932-s) [INBC]. Barcode: LACM ENT 144292.

PARATYPES. One worker, same data as holotype, barcode LACM ENT 141663 [LACM]; one worker, same data as holotype, barcode LACM ENT 141664 [MCZC]; one worker, same data as holotype, barcode LACM ENT 140642 [PSWC].

ADDITIONAL NONTYPE MATERIAL. One worker, same data as holotype, coated for SEM images [JTLC].

RANGE. Costa Rica.

ETYMOLOGY. The species is named in honor of Eladio Cruz, whose former homestead is the type locality of this new species. Eladio has contributed greatly to conservation efforts in the Peñas Blancas Valley. The name is used here as a noun in apposition.

DESCRIPTION OF WORKER. Holotype worker measurements: HW 1.179, HL 1.201, SL 0.721, EL 0.286, MeL 1.638, MeW 0.865, PrW 0.551, PrL 0.371, PrS 0.406, PrT 0.777, MTL 0.777, MFL 0.861, MFW 0.290, PrL 0.474, PrW 0.369, PpW 0.533, PtH 0.342, AL 1.507, AW 1.194.

Face to vertex margin with evenly dispersed discrete foveae, distance between foveae subequal to fovea diameter or less; interspaces sublucid, with faint areolate etchings; clypeus produced anteriorly and strongly bent ventrad, concave, with small, shallow foveae; frontal carina extends onto clypeus; separated from and passing above torulus as a differentiated carina; genae closely foveate; genal bridge irregularly rugose; mandible longitudinally striate; in anterior view, eyes asymmetrically convex, skewed ventrad; scape with flange over condyle and neck, narrowing and terete above flange, broadening and flattening distally; surface of scape finely areolate, outer lateral margin shallowly punctatorugose; vertex margin angulate and somewhat crenate; vertex shiny with coarse, longitudinal striae radiating from occiput.

Mesonotal lobes completely absent; propodeal lobes in the form of weak convexities; in dorsal view spiracular gibbosities project from sides of propodeum, extending farther than propodeal lobes; spiracle openings face posteriorly; promesonotum uniformly foveate throughout; propodeal suture with longitudinal striae; dorsal face of propodeum longitudinally striate with a few foveae; propodeal suture in the form of an arched constriction, deeper laterally than medially, in profile not impressed, posterior mesonotum and dorsal face of propodeum meeting at very shallow angle; propodeal spines long, directed posteriorly; posterior face of propodeum nearly perpendicular to dorsal face, completely smooth and shining; dorsal face of pronotum broadly rounds into lateral face; lateral face foveate on upper half, grading into longitudinally striate on ventral half; anepisternum striate-foveate; katepisternum longitudinally striate; ventrolateral face of propodeum longitudinally striate; forecoxae striate; hind femur strongly swollen medially, spindle-shaped; outer surfaces of tibiae smooth and shining, with sparse piligerous puncta; posterior face of forefemur smooth and shining.

Petiole subcylindrical, longer than high, anterior face small, smooth and shining, posterodorsal face shallowly convex, rugose-foveate; ventral margin of petiole flat, with a ventrally directed, acute anterior tooth; postpetiole with gently sloping anterior face, a broad, rounded summit, and a more steeply sloping posterior face; anterior face rugose-foveate; posterior face foveate; ventral margin short, with a prominent, acute anterior tooth; first gastral tergite completely smooth and shining; first gastral sternite with anterolateral patches of oblique rugulae, remainder shiny with sparse piligerous puncta; second gastral tergite sublucid with microreticulate sculpture.

Face with fewer than 10 short, stiff setae; pronotum with about 10 short stiff setae along anterior border; mesonotum with six or fewer short stiff setae; dorsal face of propodeum with pair of short, stiff setae on lateral lobes, or these setae absent; petiolar dorsum with two and postpetiolar dorsum with about four longer, stiff setae; first gastral tergite with sparse, extremely short, completely appressed setae, no erect setae of any kind; first gas-

tral sternite with dense, suberect, long pubescence; color entirely shining black.

BIOLOGY. The type series was collected as scattered workers in the crown of a recent treefall, in midmontane wet forest (a site with high rainfall and heavy epiphyte loads).

Procryptocerus goeldii Forel, 1899

Procryptocerus goeldii Forel, 1899:45. Syntype workers: Brazil, State of Santa Catarina, Blumenau (Möller) [MHNG] (one worker examined, here designated lectotype); Brazil, Rio de Janeiro, foot of Mt. Corcovado (Göldi) [MHNG] (one worker examined). Forel, 1907: 12 (description of queen); Kempf, 1951:46–50, fig. 16, 27, 57, 72, 74, 79, 80, 84, 89, 92 (description of nontype worker, queen, male).

RANGE. Brazil (Bahia, Minas Gerais, Paraná, Rio de Janeiro, Rio Grande do Sul, Santa Catarina, São Paulo), Paraguay.

COMMENTS. At MHNG a single Möller specimen was placed under *P. goeldii* and a single Göldi specimen under *P. bylaeus*. The latter bore a Kempf "Holotype" label. This must be a labeling error and misplacement. Both specimens are the syntypes of *goeldii*, and Kempf did not designate a lectotype for *P. goeldii*.

This species is very similar to *P. bylaeus*. The discovery of sympatric populations of the two forms in Agudos, São Paulo, led Kempf to consider them distinct species (Kempf, 1964b). We have examined additional material and provide here updated records for both species. This shows that *P. goeldii* and *P. bylaeus* are potentially sympatric over much of *P. goeldii*'s range. Further research may reveal whether there are habitat preferences or other aspects of natural history that distinguish the two species.

In all the material we have examined, the anterodorsal face of the petiole is smooth and shining in *P. goeldii*, transversely striate in *P. bylaeus*. This character appears to be consistent in these species, even though it is variable in other species of *Procryptocerus*. Other characters that distinguish *P. goeldii* from *P. bylaeus* relate to vertex sculpture and pilosity. *Procryptocerus goeldii* usually has transverse striae on the vertex, underlain with microareolate sculpture, which gives a somewhat granular appearance. Sometimes the striae are longitudinally oriented medially. *Procryptocerus bylaeus* often has the vertex nearly smooth, with a few short longitudinal striae medially, and the interspaces smooth and shining. *Procryptocerus goeldii* has very short, sparse, stiff setae on the face, mesosomal dorsum, and first gastral tergite. These setae are relatively longer, thinner, and more abundant on *P. bylaeus*.

To Kempf's description of *P. goeldii* we add HW = 1.04 on the Möller worker and 1.15 on the Göldi worker.

ADDITIONAL MATERIAL EXAMINED. BRAZIL: no specific locality (Hoboken Quarantine) [USNM]; *Bahia*: Encruzilhada, 15°31′S, 40°54′W, 980 m (Seabra and Alvarenga) [MZSP]; *Minas Gerais*: Serra Caraça, 20°08′S, 43°30′W, 1380 m (Kloss, Lenko, Martin) [MZSP]; Manhumirim, 20°22′S, 41°57′W (E.M. Oliveira) [MZSP]; Monsenhor Paulo, 21°46′S, 45°33′W (V. dos Santos) [MZSP]; *Parana*: Capão Imbuia, Curitiba, 25°25′S, 49°15′W (C. Porter, A. Garcia) [MCZC]; *Rio de Janeiro*: Petropolis, 22°31′S, 43°10′W (T. Borgmeier) [MCZC]; same data (A. Wiltuschnig) [MZSP]; Angra Dos Reis, Faz. Japuhyba (I. Trav. F.) [MZSP]; *Rio Grande do Sul*: Pareci Novo, 29°39′S, 51°24′W (B. Rambo) [MZSP]; São Leopoldo (Buck) [MZSP]; *Santa Catarina*: Nova Teutônia, 27°11′S, 52°23′W, 300 m (F. Plaumann) [MZSP]; Porto Novo (Rambo) [MZSP]; *São Paulo*: Barueri, 23°31′S, 46°53′W (K. Lenko) [MCZC]; Embu, 23°39′S, 46°51′W (E. Lane) [MZSP]; Botucatu, 22°52′S, 48°26′W (L.C. Forti) [MZSP]; Ubatuba (P.C. Montouchet) [MZSP]; Agudos, 22°28′S, 49°00′W (C. Gilbert) [MCZC]; same data (W.W. Kempf) [LACM, MCZC, MZSP, USNM]. PARAGUAY: Pastoreo, 26°50′S, 55°44′W (P. Duelli) [MZSP].

Procryptocerus hirsutus Emery, 1896

Procryptocerus hirsutus Emery 1896:96. Syntype workers: Brazil, State of Pará (Schulz) [MCSN] (examined). Kempf 1951:34–35, fig. 8, 40 (translation of Emery's description, and additional description of nontype workers).

RANGE. Brazil (Amazonas, Bahia, Goiás), Guyana, Trinidad.

COMMENTS. This species is very similar to *P. belti*, with which it has a parapatric distribution. See further comments under *P. belti* and *P. pictipes*.

ADDITIONAL MATERIAL EXAMINED. BRAZIL: *Amazonas*: Itacoatiara Highway, km 34 (W.L. and D.E. Brown) [MCZC]; Ilha de Curari (J. Adis) [LACM]; Manaus (K. Lenko) [MZSP]; Ig. Marianil, Rio Branco Rd., 24 km NE Manaus (W.L. Brown) [MCZC]; *Bahia*: Faz. São José, Mascote (F.P. Benton) [CPDC]; Itacare (J.H.G. Delabie) [CPDC]; *Goiás*: Jarai (E.M. Oliveira) [MZSP]. GUYANA: Kartabo (W.M. Wheeler) [LACM, MCZC]. TRINIDAD: Mt. Tucuche (Darlington) [MCZC].

Procryptocerus bylaeus Kempf, 1951

Procryptocerus goeldii Forel (part): Forel, 1912:207 (Santa Marta worker identified as *P. goeldii*).

Procryptocerus goeldii subsp. *bylaeus* Kempf, 1951:50–51. Holotype worker: Colombia, Naranjo, foot of Sierra Nevada de Santa Marta (Forel). Neotype worker: Brazil, Amazonas: Ilha de Curari, Várzea [3°15′S, 59°49′W], 22 Jan 1976, ex ground photoeclector (J. Adis) [LACM]. Barcode: LACM ENT 141647.

Procryptocerus bylaeus: Kempf, 1964b:247, fig. 5 (raised to species).

RANGE. Bolivia, Brazil, Colombia, Guyana, Panama, Paraguay, Peru, Trinidad, Venezuela.

DESCRIPTION OF WORKER. Neotype worker measurements: HW 1.130, HL 1.085, SL 0.715, EL 0.294, MeL 1.242, MeW 0.830, PrW 0.603, PrL 0.297, PrS 0.180, PrT 0.477, MTL 0.721, PtL 0.408, PtW 0.393, PpW 0.505, PtH 0.388, AL 1.219, AW 1.087, ASW 0.022.

Face to vertex margin with evenly dispersed discrete foveae, distance between foveae subequal to fovea diameter; interspaces with silky sheen and faint areolate etchings; clypeus abruptly bent ventrad, with a median longitudinal carina and a few longitudinal carinulae near lateral margins, other-

wise smooth with microareolate sculpture; frontal carina thickened just posterior to torulus, ending on dorsum of torulus; genae closely foveate; genal bridge longitudinally rugose; mandible longitudinally striate; in anterior view, eyes asymmetrically convex, skewed ventrad; scape with flange over condyle and neck, flattened over entire length, narrow basally, broadening distally; surface of scape finely areolate, outer lateral margin shallowly punctatorugose; vertex margin angulate but not crenate; vertex shiny with variable extent of longitudinal striae radiating from occiput.

Mesonotal lobes small, forming right angles or subacute teeth; propodeal lobes in the form of a broadly convex anterolateral margin that tapers toward propodeal teeth, or with posterolateral tooth delimiting posterior border; promesonotum foveate anteriorly, grading into variable mix of foveae and longitudinal striae posteriorly; dorsal face of propodeum longitudinally striate; propodeal suture impressed, in profile forming a distinct V-shaped notch; posterior face of propodeum perpendicular to dorsal face, completely smooth and shining; dorsal face of pronotum meets flat lateral face at rounded angle; lateral face of pronotum, anepisternum, katepisternum, and lateral face of propodeum longitudinally striate; forecoxae smooth or striate; hind femur strongly swollen medially, spindle-shaped; outer surfaces of tibiae punctatorugose; posterior face of forefemur smooth and shining.

Petiole short, anterior face with coarse transverse striae, posterior face rugose-foveate, ventral margin flat with small anterior tooth; postpetiolar dorsum evenly convex, longitudinally rugose; ventral margin short, with a prominent, acute anterior tooth; first gastral tergite finely longitudinally striate, striae superimposed on micropuncrtate sculpture (giving granular appearance), striae becoming somewhat irregular in center of disc, formed from irregular rows of small puncta; first gastral sternite with bands of subparallel longitudinal striae along lateral margins, remainder smooth and shiny with sparse piligerous puncta; second gastral tergite with micropunctate granular sculpture.

Dorsal surfaces with sparse, stiff setae, about 10 on face, 30 on promesonotum, 10 on dorsal face of propodeum, 10 on petiole, 15 on postpetiole, 30 on first gastral tergite; these setae about 0.12 mm long, longer on petiole and postpetiole; first gastral sternite with sparse suberect hairs, finer and more flexuous than dorsal setae; color black, usually with lighter red brown to orange tibiae.

DESCRIPTION OF QUEEN. Queen measurements (n = 1, Brazil, barcode LACM ENT 141637): HW 1.242, HL 1.186, SL 0.765, EL 0.375, MeL 1.719, MeW 1.022, MTL 0.838, MFL 0.940, MFW 0.324, PeL 0.502, PeW 0.439, PpW 0.588, PtH 0.455, AL 1.548, AW 1.205, ASW 0.025.

Similar to worker in most respects; pronotum, mesoscutum, axillae, and scutellum foveate; interspaces subequal to or greater than fovea diameter, with microareolate sculpture; foveae on mesoscutum distinctly elongate; dorsal face of propodeum irregularly rugose-foveate.

COMMENTS. The type of *P. bylaeus* is missing. It was not found in MHNG during Longino's 1990 visit, nor is it in MZSP (C.R. Brandão, personal communication). Therefore, we designate a neotype here.

Procryptocerus bylaeus is a South American species that barely makes it into Central America. Only one Central American specimen is known from a canopy fogging sample from near Gatun Lake, Panama.

BIOLOGY. This species inhabits wet or moist forest canopy. Collections are most often from canopy fogging samples, treefalls, or photoeclectors. The species is abundant in J. Adis' canopy ant samples from near Manaus. The P.S. Ward collection from Bolivia was from a nest in a dead twig.

ADDITIONAL MATERIAL EXAMINED. BOLIVIA: *Beni:* Rurrenabaque, Rio Beni, 14°28'S, 67°34'W (W.M. Mann) [USNM]; *Santa Cruz:* 10 km NW Terevinto, 17°40'S, 63°27'W, 380 m (P.S. Ward) [JTLC]. BRAZIL: *Amazonas:* Rio Tarumã Mirim, 3°02'S, 60°17'W, (J. Adis) [LACM]; Ilha de Curari, 3°15'S, 59°49'W (J. Adis) [LACM]; Faz. Esteio, 30 km NNE Manaus, 2°23'S, 59°46'W, 80 m (P.S. Ward) [PSWC]; Manaus-Dimona, 2°23'S, 60°06'W (F.P. Benton) [CPDC]; Manaus, 3°07'S, 60°02'W (K. Lenko) [MZSP]; same data (Y.D. Lubin) [LACM]; *Bahia:* Olivença, Ilhéus, 14°57'S, 39°01'W (J.H.C. Delabie) [CPDC]; Unacau, Una, 15°18'S, 39°04'W (J.E. Silveira) [CPDC]; CEPEC, Ilhéus, 14°45'S, 39°13'W (J.H.C. Delabie) [MZSP]; same data (A. Souza) [CPDC]; EDSABE, Una, 15°18'S, 39°04'W (S. Lacau) [CPDC]; Faz. Boca Aberta, Mucuri, 18°05'S, 39°34'W (F.P. Benton) [CPDC]; *Espirito Santo:* Linhares, 19°25'S, 40°04'W (Abreu/Niella) [CPDC]; *Goiás:* Araguacema (J.A. Rafael) [MZSP]; *Maranhão:* Bacabal (W.W. Kempf) [MZSP]; *Mato Grosso:* Sinop, 12°31'S, 55°37'W (M. Alvarenga) [MZSP]; Vila Vera, 12°4'S, 55°20'W (M. Alvarenga) [MZSP]; *Minas Gerais:* Jordânia, 15°54'S, 40°11'W (J. Brito) [CPDC]; *Pará:* no specific locality (Schulz) [MCSN]; *Piauí:* Rio Uruçui Preto (R. Negre H.) [MZSP]; *Roraima:* Ilha de Maracá, 3°25'S, 61°40'W (F.P. Benton) [CPDC]; *São Paulo:* Faz. Lageado, Botucatu (B.H. Dietz) [MZSP]; M. Aprazivel, Faz. Bacuri (Sakran) [MZSP]; Agudos, 22°28'S, 49°00'W (C. Gilbert) [MZSP]. COLOMBIA: *Amazonas:* Mico ("Monkey") Island, Rio Amazonas, 3°56'S, 70°08'W (H.A. Hespenheide) [LACM]; *Meta:* RNN La Macarena, Est. Las Dantas (F. Fernandez-C.) [CFFC]. ECUADOR: *Sucumbios:* Sacha Lodge, 0°30'S, 76°30'W, 290 m (P. Hibbs) [LACM]. GUYANA: Forest Settlement, Mazaruni River (N.W. Weber) [MCZC]; Kartabo, 6°23'N, 58°41'W (W.M. Wheeler) [USNM]. PANAMA: *Canal Zone:* Punta de los Chivos, 9°14'N, 79°56'W (canopy fogging team) [MCZC]. PARAGUAY: Independencia, near Villarica (K. Kusnezov) [MZSP]; *Caninderyú:* 6 km N Ygatimi (A. Wild) [LACM]; *Central:* San Lorenzo (B. Garcete) [LACM]; *Guaira:* Roque Gonzalez (B. Garcete) [LACM]. PERU: *Madre de Dios:* Tambopata, 12°50'S, 69°20'W, 290 m (T.L. Erwin) [LACM]. TRINIDAD: Mt. Tucache, 10°44'N, 61°25'W (Darlington) [MCZC]. VENEZUELA: *Barinas:* 17 km SSW Ciudad Bolivia, 8°02'N, 70°46'W, 240 m (P.S. Ward) [PSWC].

Procryptocerus impressus Forel, 1899, new status, status revalidated

Figs. 1G, 3E,F

Procryptocerus punctiiceps race *impressus* Forel, 1899:47–48. Syntype worker, queen: Panama, Bugaba (Champion) [BMNH] (examined, worker here designated lectotype, queen paralectotype).

Procryptocerus subpilosus impressus: Forel, 1911:263; Kempf, 1951:63.

Procryptocerus subpilosus (F. Smith) (part): Kempf, 1964a:435–436 (incorrectly synonymized under *P. subpilosus*).

RANGE. Costa Rica, Panama.

DESCRIPTION OF WORKER. Worker measurements (n = 1, Costa Rica): HW 1.499, HL 1.405, SL 0.805, EL 0.354, MeL 1.611, MeW 1.078, PrW 0.770, PrL 0.476, PrS 0.225, PrT 0.702, MTL 0.961, MFL 1.011, MFW 0.394, PtL 0.462, PtW 0.425, PpW 0.569, PtH 0.415, AL 1.672, AW 1.4751.

Head subcircular, tending to triangular; vertex concave, strongly differentiated from face by vertex margin, which is entire and coarsely crenate; face evenly convex; clypeus little differentiated from face, curving ventrad but not sharply so, following general curve of face in lateral view; anteromedian portion of clypeus slightly impressed, with a discrete tuft of golden setae; frontal carina thickened and laterally flattened just posterior to torulus, ending on dorsum of torulus; vertex completely smooth and shining or with 2–3 obscure rugae medially; face very shallowly sculptured with a mixture of somewhat irregularly distributed, large foveae (these reminiscent of lunar craters) and fine, irregular, longitudinal rugae, rugae stronger near occipital border; interspaces very finely and superficially microareolate; sculpture on clypeus similar to that on face, but with foveae more obscure; genae and mandibles coarsely longitudinally striate; scapes with a flanged skirt at base, partially covering neck and condyle; base of scape above skirt subretete, expanding distally to a broad, flat apex; scape finely and superficially microareolate, like interspaces of face.

Promesonotum in dorsal view with rounded anterior margin, straight to somewhat convex sides which converge to base of propodeum; in lateral view, mesonotum slopes throughout entire length to deep propodeal suture; lateral lobes of mesonotum in the form of horizontal flanges which are blunt, posteriorly directed, and project over the propodeal suture, such that in side view their vertically concave posteroventral margins obscure the median portion of the suture; dorsal face of propodeum with produced lateral lobes which extend about half the length of the dorsal face; posterior border of lobes subrectangular, toothlike, to gently rounded; propodeal spines about 0.4 times length of dorsal face; posterior face of propodeum perpendicular to dorsal face, concave, and completely smooth and shining; entire dorsal surface of mesosoma longitudinally striate; sides of pronotum flat to concave, meeting dorsal face at distinct angle; lateral face with coarse longitudinal striae on lower half, extending onto anepisternum, and onto metapleural region of propodeum; rest of side smooth and shining, superficially, finely microareolate; femora very strongly swollen, spindle-shaped; forefemur compressed, flattened; exterior surfaces of tibiae coarsely rugose; distal half of posterior face of forefemur weakly rugose, rest of legs smooth and shining.

Petiole short and squat, anterior face completely smooth and shining, posterior face and dorsum of postpetiole longitudinally striate, but striae nearly effaced by dense, coarse, piligerous puncta; first gastral tergite longitudinally striate throughout, striae slightly irregular, occasionally anastomosing; interspaces microareolate, giving a subopaque or granular appearance to gaster; longitudinal striae on second gastral tergite variably developed; first gastral sternite subopaque to somewhat shiny, with microareolate sculpture becoming denser near lateral margins; lateral margins with a few faint rugulae.

Setae very dense and conspicuous; setae present on legs, mandibles, scapes, lateral and posterior margins of face (absent on disc), entire mesosomal dorsum, petiole, postpetiole, and gaster; setae all stiff, those on dorsal surfaces strongly flattened (although always linear, never spatulate), suberect to decumbent; those on first gastral tergite dense enough to obscure the underlying sculpture; setae which lie on the same longitudinal line on first gastral tergite overlap up to half their length; setae on first gastral sternite abundant, subdecumbent, thinner than those on dorsum; integument entirely black, setae yellowish-white.

DESCRIPTION OF QUEEN. Queen measurements (n = 1, Costa Rica, barcode: LACM ENT 141585): HW 1.641, HL 1.563, SL 0.834, EL 0.429, MeL 2.147, MeW 1.307, MTL 1.097, MFL 1.147, MFW 0.415, PtL 0.593, PrW 0.480, PpW 0.650, PtH 0.472, AL 2.004, AW 1.661, ASW 0.030.

Similar to worker in most respects; face uniformly, sparsely foveate, foveae small, interspaces two times or more foveal diameter, interspaces with microareolate sculpture; no interspersed rugae (in contrast to the workers, which have a mixture of foveae and faint rugae); pronotum foveate laterally, each fovea with stiff, flattened seta, pronotum smooth medially with a few small foveae; mesoscutum, axillae, and scutellum with a mixture of foveae and longitudinal striae; relatively sparse setae on mesoscutum, axillae, and scutellum; dorsal face of propodeum longitudinally striate.

BIOLOGY. This species inhabits primary rainforest, where workers are encountered on low vegetation and in treefalls. In Costa Rica, it is sympatric with the very similar *P. paleatus* and *P. tortuguero*.

ADDITIONAL MATERIAL EXAMINED. COSTA RICA: *Heredia:* Casa Plastico, 17 km S Pto. Viejo, 10°18'N, 84°02'W, 550 m (J. Longino) [JTLC]; Chilamate, 10°27'N, 84°04'W, 70 m (P. Hanson) [MUCR]; La Selva Biological Station, 10°26'N, 84°01'W, 50 m (ALAS) [JNBC, JTLC]; same data (H. Hespenheide) [LACM, CHAH]; same data (J. Longino) [JTLC]; *Limón:* Tortuguero N.P., Est. Cuatro Esquinas, 10°35'N, 83°31'W, 5 m (J. Solano) [JNBC]; Hitoy Cerere Biol. Reserve, 9°40'N, 83°02'W, 100 m (J. Longino) [JTLC]; Rio Toro Amarillo, vic. Guapiles, 10°13'N, 83°48'W (W.L. Brown, Jr.) [MCZC]; 4 km NE Bribri, 9°39'N, 82°49'W, 50 m (P. Hanson) [MUCR]; *Puntarenas:* 10 km W Piedras Blancas, 8°47'N, 83°19'W, 100 m (P. Hanson) [MUCR]. PANAMA: *Chiriqui:* Chiriquí, 8°24'N, 82°19'W (F.M. Gaige) [LACM].

Procryptocerus kempfi Longino and Snelling new species

HOLOTYPE WORKER. Costa Rica, Prov. Heredia, 17 km S Puerto Viejo, 10°18'N, 84°02'W, 600 m, 24 Jan 1989, wet forest, on low vegetation (Longino #2300-s) [INBC]. Barcode: LACM ENT 141719.

PARATYPES. One worker, same data as holotype, barcode LACM ENT 141720 [JTLC]; one worker, Panama, El Valle, XI-1946 (N.L.H. Krauss), barcode LACM ENT 141718 [USNM]; one worker, Panama, Prov. Panamá, Cerro Campana, 8°40'N, 79°56'W, 850 m, 26 Jun 1977 (Hespenheide), barcode LACM ENT 141601 [BMNH]; one worker, same data, barcode LACM ENT 141600 [CPDC]; one worker, same data, barcode LACM ENT 141599 [MCZC]; one worker, same data, barcode LACM ENT 141598 [MHNG]; one worker, same data, barcode LACM ENT 141597 [MZSP]; one worker, same data, barcode LACM ENT 141596 [NHMB]; one worker, same data, barcode LACM ENT 141595 [PSWC]; one dealate queen, same data, barcode LACM ENT 141602 [INBC]; one dealate queen, same data, barcode LACM ENT 141603 [LACM]; one worker, same locality and collector, 13 Jul 1977, barcode LACM ENT 141604 [CHAH]; one worker, same data, barcode LACM ENT 141594 [GBFM]; four workers, same data, barcodes LACM ENT 141590–141593 [LACM]; one worker, same locality and collector, 17 Jul 1977, barcode LACM ENT 141589 [LACM].

RANGE. Costa Rica, Panama, Peru.

ETYMOLOGY. This species is named for W.W. Kempf, without whose efforts this contribution would have been much more difficult.

DESCRIPTION OF WORKER. Holotype worker measurements: HW 1.279, HL 1.242, SL 0.710, EL 0.352, MeL 1.562, MeW 0.925, PoW 0.666, PrL 0.450, PrS 0.222, PrT 0.672, MTL 0.881, PeL 0.509, PeW 0.341, PpW 0.450, PtH 0.367, AL 1.537, AW 1.210, ASW 0.026.

ADDITIONAL WORKER MEASUREMENTS. HW 1.16–1.31 (n = 3); MFL 0.874, MFW 0.326 (n = 1, Panama).

Face sculpture shallow; face to vertex margin with evenly dispersed discrete foveae, distance between foveae subequal to fovea diameter; interspaces subopaque, with fine areolate etchings; short, subparallel, longitudinal rugae on posteriormost one sixth of face, at vertex margin; clypeus weakly bent ventrad, anterior margin with a semicircular impression from which a median tuft of small setae emerges; clypeus weakly longitudinally striate; genae longitudinally striate; genal bridge longitudinally striate; mandible longitudinally striate; scape flattened as in *P. attenuatus*, as wide at base as at apex; flat surface of scape with microareolate sculpture; vertex margin sharply angulate and somewhat crenate; vertex almost entirely smooth and shiny or with variably developed longitudinal striae medially and laterally; eye shallowly and evenly convex.

In dorsal view, anterior and lateral margins of promesonotum evenly rounded; mesonotum with lateral lobes which have straight lateral margins nearly parallel to the longitudinal body axis, meeting flat posterior margin at slightly less than a right angle, weakly projecting; propodeum with shallow lateral lobes which extend approximately half the length of the dorsal face; mesosomal dorsum longitudinally striate over most of surface, becoming somewhat irregular and with a few foveae at anterior margin of pronotum (striae extend to anterior margin on Peru specimen); propodeal suture deep, V-shaped in profile, breaking longitudinal striae that cross it; posterior face of propodeum perpendicular to dorsal face, slightly concave, completely smooth and shining; dorsal and lateral faces of pronotum meet at an angle; lateral face somewhat concave, smooth on upper half, coarsely longitudinally striate on ventral half; anepisternum striate; katepisternum striate with variable amount of upper portion smooth; lateral face of propodeum somewhat concave, smooth on upper half, coarsely longitudinally striate on ventral half; coxae smooth or with variable presence of weak striae; hind femur strongly swollen medially, spindle-shaped; outer surfaces of tibiae coarsely rugose, subopaque; posterior face of forefemur smooth and shining or with a few oblique rugulae at upper distal margin.

Petiole subcylindrical, longer than high, with a weakly convex posterodorsal face; ventral margin weakly concave with a low, blunt anterior tooth; postpetiole with a long, gently sloping anterior face, and a broad, rounded summit near the posterior margin; ventral margin short, with a prominent, acute anterior tooth; anterodorsal face of petiole curved posteriorly, smooth and shiny; posterodorsal face of petiole and postpetiolar dorsum coarsely longitudinally striatorugose; first gastral tergite longitudinally striate, underlain with microreticulate sculpture to give slightly granular look, striae fading to leave narrow smooth band at posterior border; first gastral sternite with anterolateral patches of oblique rugulae, remainder with microreticulate sculpture and sparse piligerous puncta;

second gastral tergite with microreticulate sculpture and a few weak rugulae laterally.

Dorsal setae short, stiff, somewhat flattened, yellowish; face nearly devoid of setae, with one or two near margin of vertex; promesonotum with clusters of about six on humeri and a pair near lateral lobes; pair of converging setae in propodeal suture; dorsal face of propodeum with about 10 setae; relatively denser and longer setae on petiole and postpetiole and on first gastral tergite near postpetiolar insertion; setae sparse and short on rest of first gastral tergite, becoming longer at apex of gaster (setae on thorax and abdomen more abundant on Peru specimen); first gastral sternite with sparse subdecumbent and decumbent setae; color entirely shining black.

DESCRIPTION OF QUEEN. Paratype queen measurements (barcode LACM ENT 141602): HW 1.285, HL 1.240, SL 0.688, EL 0.384, MeL 1.718, MeW 1.029, MTL 0.865, MFL 0.933, MFW 0.339, PtL 0.549, PtW 0.341, PpW 0.463, PtH 0.359, AL 1.696, AW 1.315, ASW 0.035.

Similar to worker except for traits typical of caste. Pronotum smooth medially, irregularly foveate-rugose laterally; mesoscutum, axillae, and scutellum longitudinally striatorugose, interspersed with evenly dispersed foveae; dorsal face of propodeum) longitudinally striate.

BIOLOGY. This species is an inhabitant of montane wet forest. All records are from workers and dealate queens collected from low vegetation or treefalls.

ADDITIONAL MATERIAL EXAMINED. PERU: *Loreto:* 15 km WSW Yurimaguas, 5°59′S, 76°13′W, 200 m (P.S. Ward) [PSWC].

Procryptocerus mayri Forel, 1899

Figs. 1A, 2

Procryptocerus mayri Forel, 1899:43. Lectotype worker: Colombia (Landoli) [MHNG] (two workers examined); Kempf 1951:103–104, fig. 11, 28, 36, 68 (redescription of worker, designation of lectotype).

Paracryptocerus mayri reichenspergeri Santschi, 1921:98 [lapsus for *Procryptocerus*]. Holotype worker: Brazil (Reichensperger) [NHMB] (examined) **new synonymy.** Kempf, 1951:105.

RANGE. Colombia, Costa Rica, Venezuela, Peru, Brazil(?).

DESCRIPTION OF WORKER. Central America. Worker measurements (n = 1, Costa Rica): HW 1.678 (range 1.309–1.532, mean 1.465, n = 4), HL 1.585, SL 1.0452, EL 0.388, MeL 2.405, MeW 1.233, PrW 0.743, PrL 0.670, PrS 0.479, PrT 1.149, MTL 1.392, MFL 1.535, MFW 0.462, PtL 0.599, PtW 0.531, PpW 0.617, PtH 0.434, AL 2.106, AW 1.750.

Head subtriangular in outline, margin of vertex roughly straight; frontal carina extends onto clypeus, separated from and passing above torulus as a continuous flange; torulus trough lacking; face sculpture composed of high, sharp, well-spaced rugae; spaces between rugae smooth and shining; rugae often anastomosing to form polygons, with little longitudinal orientation (clathrate sculpture); this condition grades into increasing degrees of longitudinal orientation of rugae, especially anteriorly; rarely, rugae may be almost entirely longitudinal and subparallel; clypeus at level of antennal insertions bent ventrad; clypeus with prominent median longitudinal carina, flanked with 1–4 longitudinal carinae on each side; lateral carinae of variable strength; genae varying from longitudinally rugose to coarsely foveate/areolate; genal bridge longitudinally rugose; mandibles coarsely to weakly striate; eyes nearly symmetrically convex; scape flattened with thick lateral margin distally, becoming narrower and more terete basally, then flaring into a basal flange; broad, flat surface of scape finely areolate, outer lateral margin with coarse rugae; margin of vertex obtuse, weak, obsolete medially; vertex shiny with coarse, longitudinal striae radiating from occiput (of highly variable strength).

Mesonotal lobes short, acute, upturned; propodeal suture broadly, shallowly impressed, not breaking sculpture; anterolateral propodeal lobes absent; degree of margination between dorsal and lateral faces of propodeum variable; length of propodeal spines variable; propodeal spines vary from pointing straight back to being widely divergent; pronorum reticulate rugose, coarsely areolate anteriorly; in some specimens rugae somewhat longitudinally parallel on mesonotum; dorsal face of propodeum reticulate rugose to longitudinally striate; posterior face of propodeum meeting dorsal face at obtuse angle; posterior face of propodeum varies from completely smooth and shining with one or two transverse striae between bases of propodeal spines to mostly covered with coarse transverse striae; side of pronotum and katepisternum and side of propodeum with coarse longitudinal striae; becoming irregular on anepisternum and near dorsolateral pronotal margin; posterior surface of forefemur entirely smooth and shining; outer surface of metatibia coarsely rugose.

Ventral margin of petiole flat to weakly concave with low anterior right-angled tooth; anterodorsal face of petiole shiny with coarse to faint transverse striae (completely smooth in a few specimens); posterodorsal face areolate-foveate (weakly longitudinally rugose in some specimens); postpetiole with a long, gently sloping anterior face, a broad, rounded summit near the posterior margin, and a steeply sloping posterior face; ventral margin of postpetiole short with a prominent, acute anterior tooth; dorsum of postpetiole coarsely foveate-rugose (weakly longitudinally rugose in some specimens); first gastral tergite smooth and shining or occasionally with faint rugae anteriorly near petiolar insertion; first gastral sternite largely microreticulate, nearly smooth; second gastral tergite with faint, dense, granular sculpture.

Abundant flexuous setae on face, mesosomal dorsum (>20 on central area of promesonotum, not including those on lateral margins), petiole and

postpetiole, and gaster; first gastral tergite with sparse, whitish pubescence under the erect setae or lacking underlying pubescence; color shining black, legs black or occasionally red.

Lectotype Worker. Worker measurements: HW 1.951, HL 1.799, SL 1.203, EL 0.481, MeL 2.556, MeW 1.370, PrW 0.931, PrL 0.624, PrS 0.486, PrT 1.11, MTL 1.606, MFL 1.707, MFW 0.535, PtL 0.617, PtW 0.521, PpW 0.593, PtH 0.490, AL 2.037, AW 1.890.

The type of *P. mayri* differs from Costa Rican material primarily by being larger. Also, the face is more uniformly striate, less clathrate. The legs are red.

Holotype of *reichenspergeri*. Worker measurements: HW 1.885, HL 1.825, SL 1.200, EL 0.482, MeL 2.553, MeW 1.400, PrW 0.993, PrL 0.701, PrS 0.472, MTL 1.601, MFL 1.690, MFW 0.534, PtL 0.589, PtW 0.572, PpW 0.648, PtH 0.521, AL 1.969, AW 1.960.

The type of *P. reichenspergeri* is nearly identical to the type of *P. mayri*, but the legs are black instead of red. Leg color seems to be variable within populations, and we conclude that *P. reichenspergeri* is a synonym of *P. mayri*. The only locality data for *P. reichenspergeri* is "Brazil" on the label of the type. No other specimens of *P. mayri* have been recorded from Brazil, so this lone type specimen is something of a mystery.

Other South American Material Identified as *P. mayri*. The following specimens are all very similar to the type, with only slight differences in the degree of longitudinal versus clathrate sculpture on the face, and the color of the legs. Two specimens from Venezuela (Rancho Grande) have HW's 1.95 mm and 2.12 mm and red legs. A specimen from Colombia, Dept. Valle, has HW 1.72 and black legs (two other specimens in this series are similar). One specimen from Colombia, Dept. Nariño, has HW 1.748 and red legs. One specimen from Peru has HW 1.62 and dark red legs. The face sculpture on this specimen is somewhat shallower than the type.

Additional specimens from Colombia, Ecuador, and Peru begin to blur the distinction between *P. mayri* and other forms in this complex. Further work is needed in this region.

Variation in Frontal Carinae. On most *P. mayri* from Costa Rica and the series from Valle Dept., Colombia, the portion of the frontal carina that curves mesad above the torulus is well separated from the torulus and remains relatively elevated (and higher than wide) to the point where it joins or parallels the lateral clypeal carina. On a few Costa Rican specimens, the types of *P. mayri* and *P. reichenspergeri*, the specimens from Rancho Grande, Venezuela, and the specimen from Peru, the frontal carina tapers as it curves mesad and becomes little more than a raised line, no higher than wide, that crosses the dorsum of the torulus and approaches the lateral clypeal carina.

DESCRIPTION OF QUEEN. The queen, previously unknown, is described based on Costa Rican material. Queen measurements (n = 1, Costa Rica): HW 1.95, HL 1.78, SL 1.19, EL 0.47, MeL 2.88, MeW 1.69, MTL 1.59, PtL 0.72, PtW 0.58, PpW 0.71, PtH 0.55, AL 2.34, AW 2.04.

Characters of the head, legs, petiole, postpetiole, and gaster similar to worker.

Pronotum and anterior portion of mesoscutum coarsely areolate-foveate. On the posterior half of the mesoscutum and on the scutellum the interspaces become increasingly aligned as longitudinal rugae between the foveae. Dorsal face of propodeum with a variable extent of the median area verniculate-longitudinally rugose, lateral margins areolate-foveate. Dorsal half of posterior face with 3–4 strong transverse carinae, ventral half smooth and shining. Pronotal sculpture extends onto sides, grading into wavy longitudinal carinae. Most of katepisternum and side of propodeum longitudinally carinate. Ventral half of anepisternum longitudinally carinate or smooth, dorsal half areolate-foveate, like pronotum.

Based on separate collections of six *P. mayri* queens and six *P. batesi* queens, there is a sculptural difference between the two species. Queens of *P. mayri* have the ventral half of the anepisternum smooth or longitudinally carinate. Queens of *P. batesi* have the anepisternum entirely areolate-foveate, with at most a narrow ventral strip smooth or with 1–2 longitudinal carinae.

COMMENTS. Neither of the two workers at MHNG bore a Kempf lectotype label. One worker was subsequently borrowed, detailed measurements were made, and a Lectotype label was added.

See additional comments on this species complex under *P. batesi*.

BIOLOGY. In Costa Rica, *Procryptocerus mayri* and *P. batesi* are nearly always found together, and they are restricted to wet montane forest. They occur commonly in cloud forest habitats, reach their peak abundances between 1000 and 1500 m, and drop out at lower elevations where other species of *Procryptocerus* become more abundant. The restriction to montane forest is vividly illustrated on the Osa Peninsula in southwestern Costa Rica. Most of the peninsula is well below 500 m elevation, but a few ridges in the center attain 700 m, where there is a very small patch of vegetation with the aspect of a cloud forest. In spite of nearly two year's experience on the peninsula by one of us (J.T.L.), *P. mayri* and *P. batesi* were only found during a two-day trip to this cloud forest, where they were abundant on low vegetation.

The following nest data are extracted from field notes. All are from Costa Rica (see Material Examined).

Rio Lagartos below Santa Elena de Monteverde (J. Longino). Riparian forest patch along stream. An acanthaceous gangly shrub (probably *Justicia*) overhanging stream had scattered workers on it. Two nests were in the lower branches of the plant, and the entrances pointed downwards and were easily seen from below. One nest was 49 cm long,

Table 1. Contents of two *Procryptocerus mayri* nests in close proximity in live stems of acanthaceous shrub.

	First nest	Second nest
Adult workers	48	64
Alate queens	13	36
Adult males	12	7
Queen pupae	15	32
Worker pupae	11	6
Prepupae	5	5
Large larvae	12	29
Small larvae	9	15
Eggs	Few	Few

entirely within a live, 14-mm-diameter branch, with a single, centrally located, circular entrance hole. The walls of the chamber were very smooth and clean. The second nest was in a live branch with a dead apex; 4 cm of the nest in live stem, 52 cm in dead. It had two lateral entrance holes 30 cm apart. A third branch, near the previous two, had an externally visible entrance hole identical to those of the *Procryptocerus* nests, but the branch contained a populous *Camponotus* nest. The entire contents of the two *Procryptocerus* nests were collected (Table 1). The nests contained workers, sexuals, and brood, but no colony queen, which suggests they were parts of a polydomous colony.

Wilson Botanical Garden (J. Longino). On 28 Feb 1989, small saplings of *Cecropia obtusifolia* were examined along a river bank in forest. The apical internodes contained founding *Azteca* queens, but the lower internodes contained colonies of other genera, most commonly *Procryptocerus mayri* and *Heteroponera panamense*. Nests of *Procryptocerus* occupied single internodes, but some saplings contained more than one nest. The contents of six nests were recorded (Table 2). A number of workers bore a peculiar pale patch on the first gastral tergite, where the integument appeared thin, deformed, and weakly sclerotized.

Monteverde, 1340 m (J. Longino). Wet forest edge; lone queen in soft rotten stick lodged in vegetation; a *Camponotus* nest was in the same stick.

Twenty-two kilometers North of Volcán Barba (J. Longino). Wet forest; nest containing workers, alate queens, males, and larvae in the live trunk of a tree sapling.

Rara Avis, 17 km South of Pto. Viejo (J. Longino). Wet forest; nest in live branch of melastome tree; entire nest collected; contained 11 workers, 5 worker pupae, 2 prepupae, 6 larvae, 2 eggs.

One kilometer North of La Ese (P.S. Ward). Roadside; nest in dead twig of *Baccharis trinervis*.

In summary, *P. mayri* nests in a variety of plant stems, most often live ones. Individual nests contain fewer than 100 workers, but the frequent lack of dealate queens in nests suggests polydomy. The small amount of brood relative to adult workers and the absence of any signs of stored food suggest a long-lived worker population with a low rate of worker production. The presence of queen pupae, callows, and fully sclerotized adults together in the same nest suggests a gradual production of sexuals, and probably their gradual release.

ADDITIONAL MATERIAL EXAMINED. COLOMBIA: *Nariño*: Territorio Kofan, 0°30'N, 77°13'W, 1000 m (E. L. González) [CFFC]; *Valle*: Medio Calima, Río Bravo, 3°55'N, 76°35'W (W. Mackay) [CWEM, JTLC, LACM]. COSTA RICA: *Alajuela*: Peñas Blancas Valley, 10°18'N, 84°42'W, 940 m (J. Longino) [LACM]; Casa Eladio, Río Peñas Blancas, 10°19'N, 84°43'W, 800 m (J. Longino) [LACM]; Laguna, Peñas Blancas Valley, 10°20'N, 84°43'W, 1000 m (J. Longino) [LACM]; 1.5 km SE Cariblanco, 10°16'N, 84°10'W, 800 m (H. Hespenheide) [LACM]; *Heredia*: 22 km N Volcán Barba, 10°20'N, 84°04'W, 500 m (J. Longino) [JTLC, INBC, LACM]; Rara Avis, 17 km S Pto. Viejo, 10°18'N, 84°03'W, 700 m (J. Longino) [LACM]; same data (J. Rifkind) [LACM]; 16 km N Vol. Barba, 10°17'N, 84°05'W, 950 m (J. Longino) [JTLC, LACM]; *Puntarenas*: Cerro Rincon, Corcovado National Park, 8°33'N, 83°29'W, 700 m (J. Longino) [LACM]; Monteverde, 10°18'N, 84°48'W, 1400 m (J. Longino) [LACM]; Santa Elena [Río Lagartos], 10°19'N, 84°51'W, 1100 m (J. Longino) [JTLC, INBC, LACM, MZSP]; San Luis Valley, 10°17'N, 84°47'W, 1100 m (J. Longino) [LACM]; Wilson Botanical Garden, 4 km S San Vito, 8°47'N, 82°58'W, 1200 m (J. Longino) [JTLC, LACM]; 5 km SW Las Alturas, 8°55'N, 82°52'W, 1240 m (J. Longino) [LACM]; Monteverde, 10°18'N, 84°48'W, 1400 m (H. Hespenheide) [LACM]; *San José*: Bajo La Hondura, Braulio Carrillo Nat. Park, 10°04'N, 83°59'W, 1100 m (J. Longino) [LACM]; 1 km N La Ese, 9°27'N, 83°43'W, 1400 m (P.S. Ward) [PSWC]; 9.5 km E tunel, Braulio Carrillo Nat. Park, 10°07'N, 83°58'W, 1000 m (F. Hanson) [MUCR]; Carrillo, Braulio Carrillo Nat. Park,

Table 2. Contents of *Procryptocerus mayri* nests in *Cecropia obtusifolia* saplings. Saplings were approximately 2 m tall. One contained three nests, the rest contained one.

Collection number*	Sapling number	Adult workers	Dealate queens	Adult males	Brood
2397	1	75	1	0	+
2398	1	46	0	0	+
2399	1	55	1	0	+
2400	2	49	0	0	+
2401	3	31	0	0	+
2403	4	94	1	6	+

* Longino accession number.

10°09'N, 83°55'W, 500 m (J. Longino) [LACM]; La Montura, Braulio Carrillo Nat. Park, 10°17'N, 83°58'W, 1000 m (P. DeVries) [LACM]. PERU: *Junin*: Colonia Perene, 10°53'S, 75°13'W (Cornell Expedition) [LACM]. VENEZUELA: *Aragua*: Rancho Grande, 10°21'N, 67°41'W, 1100 m (R.W. Poole) [MCZC]; same data (W.L. and D.E. Brown) [MCZC].

Procryptocerus nalini Longino and Snelling new species

Fig. 1H

HOLOTYPE WORKER. Costa Rica, Prov. Heredia, Est. Biol. La Selva, 10°26'N, 84°00'W, 50–150 m, Apr 1993 (INBio-OET) [INBC]. Barcode: INBIOCRI001238551.

PARATYPES. One dealate queen, same data as holotype, barcode INBIOCRI001238577 [INBC]; one worker, same data, barcode INBIOCRI001238558 [BMNH]; one worker, same data, barcode INBIOCRI001238550 [CPDC]; one worker, same data, barcode INBIOCRI001238549 [LACM]; one worker, same data, barcode INBIOCRI001238544 [MCZC]; one worker, same data, barcode INBIOCRI001238546 [MHNG]; one worker, same data, barcode INBIOCRI001238545 [MZSP]; one worker, same data, barcode INBIOCRI001238582 [NHMB]; one worker, same data, barcode INBIOCRI001238578 [PSWC]; one worker, same data, barcode INBIOCRI001238559 [USNM]; one worker, same locality data, 15–21 July 1986 (J. Longino #1398-s), barcode LACM ENT 141721 [JTLC]; one dealate and one alate queen, same locality data, 15–21 July 1986 (J. Longino #1422-s), barcode LACM ENT 141722 [LACM]; one worker, same locality data, 21–23 April 1989 (H.A. Hespenheide), barcode LACM ENT 141723 [CHAH]; one worker and one male, same locality data, April 1993 (J. Longino #3456), barcode INBIOCRI001238599 [INBC]; one worker and one male, same data, barcode INBIOCRI001238600 [LACM]; one worker and one dealate queen, same data, barcode INBIOCRI001238598 [JTLC].

RANGE. Costa Rica, Peru.

ETYMOLOGY. The senior author names this species in honor of his lovely wife Dr. Nalini Nadkarni, who has contributed to knowledge of the rainforest canopy. It is used here as a noun in apposition.

DESCRIPTION OF WORKER. Holotype worker measurements: HW 0.996, HL 0.962, SL 0.583, EL 0.272, MeL 1.211, MeW 0.698, PrW 0.475, PrL 0.334, PrS 0.186, PrT 0.520, MTL 0.678, PtL 0.412, PtW 0.299, PpW 0.429, PtH 0.298, AL 1.271, AW 1.029.

ADDITIONAL WORKER MEASUREMENTS. HW (range 0.98–1.05, mean 1.02, n = 15); MFL 0.725, MFW 0.258 (n = 1).

Head roughly circular in outline; face to vertex margin with evenly dispersed discrete foveae, distance between foveae subequal to fovea diameter; interspaces subopaque with fine areolate etchings; posterior margin of clypeus impressed, clypeus weakly bent ventrad, anterior margin with a semicircular impression from which a median tuft of small setae emerges; clypeus weakly longitudinally striate; genae sparsely foveate; genal bridge longitudinally striate; mandible with weak longitudinal striae; scape flattened as in *P. attenuatus*, as wide at base as at apex; vertex margin angulate but smooth, not carinate or crenate; vertex varying from coarsely striate to nearly smooth and shining, often with only a few short striae radiating from the occiput medially and far-laterally.

In dorsal view, anterior margin of pronotum evenly rounded, sides weakly convex; mesonotum with short, blunt lateral teeth, ending well before deep propodeal suture; propodeum with subparallel-sided lateral lobes which extend approximately half the length of the dorsal face; propodeal spines slightly over half the length of the dorsal face of propodeum; pronotum and anterior half of mesonotum alveolate-foveate, grading to longitudinal rugae on posterior half of mesonotum and dorsal face of propodeum, approximately 13 rugae across propodeum at level of lateral lobes; posterior face of propodeum perpendicular to dorsal face, slightly concave, completely smooth and shining except for a few longitudinal rugae extending a short distance between the propodeal spines; entire lateral surface of mesosoma and all coxae with coarse longitudinal striae similar in density to those on dorsal face of propodeum; hind femur strongly swollen medially, spindle-shaped; outer surfaces of tibiae very faintly sculptured, subopaque; posterior surface of forefemur obliquely striate; rest of legs smooth and shining.

Petiole subcylindrical, longer than high, with a weakly convex posterodorsal face; ventral margin flat with a small anterior tooth; postpetiole with a long, gently sloping anterior face, a broad, rounded summit near the posterior margin, and a steeply sloping posterior face; ventral margin short, with a prominent, acute anterior tooth; anterior face of petiole small, faintly sculptured, subopaque; dorsum of petiole and postpetiole largely covered with coarse, piligerous foveae, posterior half of petiole and anterior half of postpetiole with longitudinal rugae; Costa Rican specimens with first gastral tergite very smooth and shining with widely dispersed small puncta; in certain lighting conditions, the faintest undulations can be observed on the anterior third of the tergum, as though striae similar to those observed on *P. attenuatus* and *P. coriarius* had become obsolete; Peruvian specimens like *coriarius*, with anterior third to half of first gastral tergite with feeble irregular longitudinal rugae with interspersed puncta, this sculpture fading to nearly smooth and shiny posteriorly; first gastral sternite with a few distinct striae confined to the anterolateral margins, remainder smooth and shining with uniformly distributed sparse puncta.

Setae long, erect, very fine and flexuous; setae are present on legs, scapes, mandibles, margins of head,

very sparse but a few present on frons, moderately abundant and evenly dispersed on mesosomal dorsum, abundant on petiole and postpetiole, clustered on anterior, posterior, and lateral margins of first gastral tergite, very sparse on dorsal disc, there underlain with very sparse, short, appressed setae; first gastral sternite covered with a moderately dense, suberect pubescence; color entirely shining black.

DESCRIPTION OF QUEEN. Paratype queen measurements (barcode INBIOCRI001238577): HW 1.065, HL 1.059, SL 0.627, EL 0.316, MeL 1.436, MeW 0.883, MTL 0.729, MFL 0.819, MFW 0.274, PtL 0.486, PtW 0.328, PpW 0.471, PtH 0.312, AL 1.489, AW 1.120.

Similar to worker except for traits typical of caste. Pronotum, mesoscutum, axillae, and scutellum coarsely and continuously foveate, dorsal face of propodeum longitudinally striate. Wings smoky brown.

BIOLOGY. This species is an inhabitant of wet forest canopy. It is moderately abundant at La Selva Biological Station, where it has been collected in Malaise traps, canopy fogging samples, and from several fresh treefalls. One nest has been observed: it was in a thin dead stem in the crown of a recently felled *Carapa guianensis* tree, and contained brood, several workers, a dealate queen, and several adult males. The P.J. Stern collection was "ex *Triplaris*."

ADDITIONAL MATERIAL EXAMINED. PERU: *Madre de Dios*: Tambopata, 12°50'S, 69°20'W, 290 m (T.L. Erwin) [LACM]; 20 km NW Manu, 12°05'S, 71°00'W, 400 m (P.J. Stern) [PSWC]; Cuzco Amazonico, 15 km NE Puerto Maldonado (Tobin and Cover) [MCZC].

Procryptocerus paleatus Emery, 1896

Figs. 1E, 3C,D

Procryptocerus paleatus Emery, 1896:97. Holotype worker: Costa Rica, Atirro, near Jimenez [MCSN] (examined).

Procryptocerus paleatus (part, see under *P. tortuguero*): Kempf, 1951:53–55, fig. 1, 20, 50, 67.

RANGE. Costa Rica, Mexico, Panama.

DESCRIPTION OF WORKER. Worker measurements (n = 1, Costa Rica): HW 1.537, HL 1.455, SL 0.800, EL 0.332, MeL 1.716, MeW 1.119, PrW 0.741, PrL 0.483, PrS 0.218, PrT 0.702, MTL 1.034, PtL 0.492, PtW 0.436, PpW 0.593, PtH 0.422, AL 1.746, AW 1.419, ASW 0.031.

Differing from *P. impressus* in the following respects: clypeus somewhat differentiated from face, upper margin slightly impressed, interantennal region slightly protruding, forming a stronger bend than in *P. impressus*; mesonotal teeth small, squared-off posteriorly, well before propodeal suture; propodeal suture shallow, mesonotum and dorsal face of propodeum in same plane; on some workers, dorsal striae do not attain anterior pronotal border, being replaced by coarse piligerous foveae; posterior face of forefemur longitudinally rugose throughout; setae similar to *P. impressus* in form and distribution, but less dense, particularly on first gastral tergite; setae on disc of first gastral tergite sparse, widely spaced, not overlapping.

Differing from *P. subpilosus* in the relatively shorter petiole and from *P. tortuguero* in the absence of erect setae on the frons. Also, unlike both *P. subpilosus* and *P. tortuguero*, the striae on the first gastral tergite extend to the posterior margin.

DESCRIPTION OF QUEEN. Queen measurements (n = 1, Costa Rica, barcode INBIOCRI001282946): HW 1.400, HL 1.342, SL 0.767, EL 0.396, MeL 1.782, MeW 1.102, MTL 0.989, MFL 0.993, MFW 0.351, PtL 0.513, PtW 0.412, PpW 0.562, PtH 0.419, AL 1.628, AW 1.376, ASW 0.030.

Similar to worker in most respects; face uniformly, sparsely foveate, foveae larger than on *P. impressus*, interspaces subequal to fovea diameter, interspaces subopaque, with microareolate sculpture (interspaces somewhat shinier on *P. impressus*); interspersed rugae very weak to absent (in contrast to the workers, which have a mixture of foveae and abundant shallow rugae); pronotum foveate laterally, each fovea with stiff, flattened seta; fovea density lower on medial pronotum, but foveae still large (in contrast to *impressus*, which has medial foveae absent or reduced to small puncta); mesoscutum, axillae, and scutellum with a mixture of elongate foveae and longitudinal striae; relatively sparse setae on mesoscutum, axillae, and scutellum; dorsal face of propodeum longitudinally striate.

The above description is based on five queens from Costa Rica. One queen from Los Tuxtlas, Mexico, differs in being much more workerlike. The face sculpture is like the worker (with a greater abundance of rugae and a reduced development of discrete foveae), and the pronotum is uniformly closely foveate, with no decrease in fova density medially.

COMMENTS. One Mexican worker (Veracruz Prov., S. Lucrecia, April 1923 [W.M. Mann] [USNM]), which Kempf (1951) identified as *P. paleatus*, is *P. scabriusculus*.

BIOLOGY. *Procryptocerus paleatus* is restricted to primary rainforest, where workers have been collected on low vegetation and in treefalls. At Corcovado National Park, workers were very rarely encountered on low vegetation, yet occurred in nearly every treefall or canopy sample. *Procryptocerus paleatus* is common in canopy fogging samples from La Selva Biological Station.

ADDITIONAL MATERIAL EXAMINED. COSTA RICA: *Heredia*: Casa Plastico, 17 km S Pto. Viejo, 10°18'N, 84°02'W, 550 m (J. Longino) [JTLC]; 22 km N Volcán Barba, 10°20'N, 84°04'W, 500 m (J. Longino) [LACM]; La Selva Biological Station, 10°26'N, 84°01'W, 50 m (H.A. Hespenheide) [CHAH, JTLC, LACM]; same data (ALAS) [INBC, JTLC]; same data (J. Longino) [JTLC, INBC, LACM]; *Puntarenas*: Sirena, Corcovado National Park, 8°29'N, 83°36'W, 5 m (G. Fonseca) [INBC]; same data (J. Longino) [LACM]; Bijagual, Carara

Biol. Reserve, 9°47'N, 84°36'W, 500 m (P. Hanson) [MUCR]; same data (P.S. Ward) [PSWC]; 5 km N Ciudad Neily, 8°42'N, 82°57'W, 780 m (P.S. Ward) [PSWC]; *San José*: Carrillo, Braulio Carrillo Nat. Park, 10°09'N, 83°55'W, 500 m (J. Longino) [LACM]. MEXICO: *Veracruz*: Los Tuxtlas, 10 km NNW Sontecomapan, 18°35'N, 95°05'W, 200 m (H. Hespenheide) [CHAH, LACM]. PANAMA: *Chiriqui*: Chiriqui, 8°24'N, 82°19'W (F.M. Gaige) [LACM].

Procryptocerus pictipes Emery, 1896
Fig. 1C

Procryptocerus pictipes Emery, 1896:98. Holotype worker: Costa Rica, Suerre, near Jimenez [MCSN] (examined). Kempf, 1951:42–45, fig. 10, 26, 52, 64 (description of nontype worker, queen).

Procryptocerus striatus scabriusculus var. *parva* Menozzi, 1935:196 (unavailable name). Worker(s): British Guiana, Kuruduni River (identification by Kempf, 1951: 42).

RANGE. Bolivia, Brazil (Amazonas, Bahia, Goiás, Pará, Pernambuco), Colombia, Costa Rica, Ecuador, Guyana, Panama, Peru, Trinidad, Venezuela.

DESCRIPTION OF WORKER. Worker measurements (n = 1, Costa Rica): HW 0.90, HL 0.90, SL 0.58, EL 0.27, MeL 1.13, MeW 0.64, PrW 0.52, PrL 0.27, PrS 0.21, PrT 0.48, MTL 0.57, MFL 0.66, MFW 0.21, PtL 0.32, PtW 0.29, PpW 0.40, PtH 0.29, AL 1.13, AW 0.96, ASW 0.022.

Head roughly circular in outline; frontal carina closely appressed to torulus, in the form of a thin raised line where it passes over dorsum of torulus and onto clypeus; face to vertex margin with shallow, irregular foveae; interspaces between foveae of variable width, from thin lines to as wide as foveae, with fine granular sculpture; interiors of foveae with fine areolate etchings, not smooth and shining; clypeus bent ventrad at level of antennal insertions; clypeus longitudinally rugose, with prominent median ruga and 2–3 rugae on each side, these variably developed and sometimes absent; genae with closely spaced foveae; genal bridge longitudinally rugose; mandible with coarse longitudinal striae to relatively smooth with a granular surface; eyes weakly convex, slightly skewed ventrad; scape flattened with thick lateral margin distally, becoming narrower and more terete basally, then flaring into a basal flange; margin of vertex angulate, weakly crenate; vertex with some coarse striae radiating from the occiput, otherwise smooth and shiny.

In dorsal view, mesonotum with small weakly elevated, subacute teeth; propodeal suture a broad, shallow trough, not breaking sculpture; dorsal face of propodeum with anterolateral lobes distinct, subrectangular, with variably developed posterolateral angle; pronotum foveate; mesonotum and dorsal face of propodeum with continuous longitudinal striae; posterior face of propodeum perpendicular to dorsal face, slightly concave; completely smooth and shining; parallel longitudinal striae cover lateral pronotum, anepisternum, katepisternum, and lateral propodeum; forecoxae smooth, hindcoxae striate; hind femur strongly swollen medially, spindle-shaped; posterior surface of forefemur smooth; outer surface of metatibia largely smooth and shiny, with a few faint rugae.

Ventral margin of petiole flat, lacking anteroventral tooth, or at most with a weak tubercle; anterodorsal face of petiole smooth and shining or transversely rugose; posterodorsal face longitudinally rugose; postpetiole with a long, gently sloping anterior face, a broad, rounded summit near the posterior margin, and a steeply sloping posterior face; ventral margin of postpetiole short with a prominent, acute anterior tooth; dorsal surface of postpetiole longitudinally rugose; first gastral tergite sculpture highly variable, from uniformly punctate to smooth, and from nonstriate to regularly longitudinally striate (see Comments below); anterolateral portion of first gastral sternite with oblique longitudinal striae, these fading medially and posteriorly; remainder of sternite smooth with microreticulate sculpture; second gastral tergite longitudinally striate.

Short, stiff setae uniformly distributed on disc of face and mesosomal dorsum; about 20 on disc of face, about 0.05 mm long; somewhat longer stiff setae on petiole, postpetiole, and anterior portion of first gastral tergite; setae on first gastral tergite erect, clustered near postpetiolar insertion, becoming sparser and shorter posteriorly; appressed pubescence on first gastral tergite extremely short and sparse; color largely black, with contrasting orange scapes and tibiae.

DESCRIPTION OF QUEEN. Based on specimen from Brazil, Pernambuco: Recife, LACM ENT 140153). Queen measurements: HW 1.023, HL 0.991, SL 0.670, EL 0.352, MeL 1.565, MeW 0.919, MTL 0.704, MFL 0.772, MFW 0.278, PtL 0.422, PtW 0.335, PpW 0.478, PtH 0.345, AL 1.461, AW 1.142, ASW 0.027.

Similar in most respect to worker; face with deeper, more discrete foveae than on worker, intervals subequal to fovea diameter medially, more closely spaced laterally; intervals opaque, sericeous; pronotum evenly foveate like face, but foveae deeper; mesoscutum, axillae, and scutellum with elongate foveae and raised, subsericeous, longitudinal intervals; dorsal face of propodeum longitudinally striate. See also Kempf (1951:42).

COMMENTS. The sculpture on the first gastral tergite varies geographically, as follows: (1) Central America and Ecuador: distinctly striate; striae moderately regular; underlying micropunctate sculpture weak, giving somewhat shiny appearance; (2) Amazonian Peru, Bolivia: striae pronounced and regular; underlying micropunctate sculpture strong, giving granular appearance; (3) central Amazonian region to coast, Guyana, Venezuela: striae weak, poorly organized; micropunctate sculpture strong, giving granular appearance; (4) two isolated specimens, Colombia, Rio Porce, and Brazil, Goiás, Jataí: striae and micropunctate sculpture both nearly effaced. The Rio Porce specimen is shinier than the Jataí specimen. The former appears derived from

typical Central American stock, while the latter appears derived from Amazonian stock. Striae are nearly always visible at the posterior border, even when largely effaced elsewhere. Sculpture on the second gastral tergite varies on small spatial scales (e.g., within Costa Rica). The tergite is often uniformly striate, but striae may be effaced medially or entirely.

Species with which *P. pictipes* is phenetically similar are *P. belti, P. hirsutus, P. convexus,* and *P. lepidus.* One specimen (Brazil, MT: Sinop, 12°31'S, 55°37'W, Dec 1974 [M. Alvarenga] [MZSP]), as yet unidentified and probably a new species, shares characters of *P. belti* and *P. convexus.* The face is shallowly areolate, like *P. convexus.* The frontal carinae are closely appressed to the torulus and the clypeus is not at all produced, like *P. convexus* and *P. pictipes.* The first gastral tergite is densely microPunctate, with abundant long erect and decumbent setae, like *P. belti.* The entire promesonotum is irregularly foveate, like *P. belti.*

A phylogenetic hypothesis heads from *P. rudis*-group species to *P. beltilhirsutus* to the Sinop specimen to *P. convexus* and finally to *P. pictipes.* In this series, one can see the gradual evolution of foveate facial sculpture, starting with the pronounced clathrate sculpture of the *P. rudis*-group. In this scenario, the high clathrate sculpture and elevated frontal carinae are plesiomorphic. Speciation produces *P. belti,* with character shifts toward smaller size, dense punctate sculpture on the first gastral tergite, and dense erect and appressed setae on the first gastral tergite. As the lineage spreads from a Central American or Andean origin into the Amazon, it becomes larger and develops longitudinal striae on the mesonotum. This is *P. hirsutus,* parapatric with *P. belti.* Somewhere within the range of *P. beltilhirsutus,* speciation produces a new form in which the frontal carinae become closely appressed to the dorsum of the torulus, resulting in a somewhat shorter clypeus, and the clathrate face sculpture becomes very shallow. This is the specimen from Sinop. This new lineage is capable of coexisting with the *P. beltilhirsutus* lineage. As it spreads, it loses the dense setae on the gaster, leaving only sparse erect setae, clustered near the postpetiolar insertion. One form loses the punctate sculpture and becomes *P. convexus.* Another form develops the beginning of facial foveae. The polygons of the shallow clathrate sculpture become more rounded, as the walls thicken, and the floors of the foveae lose the shininess and develop microareolate sculpture. Also, the punctation on the first gastral tergite begins to align and incipient striae are formed. This form, *P. pictipes,* is very successful and spreads throughout the Amazon and into the Andes and up to Costa Rica. As it moves, the first gastral tergite becomes more regularly striate, and the underlying punctation weakens.

It may be that *P. convexus* and the Sinop form represent peripheral populations that speciated through allopatry, generating *P. pictipes,* which then spread northward and westward. This would follow the traditional view of speciation occurring at the edges of ranges. Alternatively, we could be seeing the results of "centripetal speciation" of Brown, in which successive waves of new forms spread from the center. *Procryptocerus pictipes* may be the newest lineage, spreading and displacing earlier *P. pictipes*-like forms. The Sinop form and *P. convexus* would then represent ancestral forms, previously with larger ranges, and now occurring as relicts at the edges of the range of *P. pictipes.*

The relationship with *P. lepidus* is unclear. *Procryptocerus lepidus* occurs in southeastern Brazil and may be a parapatric version of *P. pictipes.* One series (Brazil: Minas Gerais: Lavras, 20 Oct 1978 [W.D. Fronk] [MCZC]), appears intermediate between *P. pictipes* and *P. lepidus.* This series has the first gastral tergite striate and punctate, much like Bolivian and eastern Peruvian *P. pictipes,* but the face sculpture is more linearly arranged rather than foveate.

BIOLOGY. *Procryptocerus pictipes* has been collected from wet forest areas, typically as workers from low vegetation, canopy, or recent treefalls. One nest series was collected in Venezuela from a dead twig in a treefall. The species is relatively common in canopy fogging samples from La Selva Biological Station in Costa Rica.

ADDITIONAL MATERIAL EXAMINED. BOLIVIA: Santa Cruz: 11 km NE Asertadero Moira, 14°29'S, 61°08'W, 180 m (P.S. Ward) [JTLC]. BRAZIL: Amazonas: Rio Tarumã Mirim, 3°02'S, 60°17'W (J. Adis) [LACM]; Manaus-K342, 3°07'S, 60°02'W (F.P. Benton) [CPDC]; Reserva Flor. A. Ducke, Manaus, 2°55'S, 59°59'W (J. Adis) [CPDC]; Manaus, 3°07'S, 60°02'W (Brandão and Diniz) [MZSP]; Manaus, Tropical Hotel (J.C. Trager) [MZSP]; *Bahia:* Ubaitaba, 14°18'S, 39°20'W (J.G.S. do Carmo) [CPDC]; F. Bom Jesus, Maraú, 14°06'S, 39°00'W (J.C.S. do Carmo) [CPDC]; Faz. Sta. Rita, Ilhéus, 14°49'S, 39°02'W (F.P. Benton) [CPDC]; Olivença, Ilhéus, 14°57'S, 39°01'W (J.H.C. Delabie) [CPDC]; Faz. Piedade, Una, 15°18'S, 39°04'W (C. Alves) [CPDC]; *Goiás:* Jataí, 17°53'S, 51°43'W (P. Pereira, M. Carreira) [MZSP]; *Para:* Tucuruí, Margem esq. (W.L. Overal) [LACM]; Transamazonica, km 109 (A.C. Mendes) [CPDC]; Caldeirao, Rio Itacaiunas (Brandão and Benson) [MZSP]; Cachoeira do Breu (Sampaio) [MZSP]; Conceicao do Araguaia, 8°14'S, 49°18'W (J.A. Rafael) [MZSP]; *Pernambuco:* Recife, 8°03'S, 34°54'W (L. Lima Castro) [MZSP]; Tapera (Pickel) [MZSP]. COLOMBIA: *Antioquia:* Rio Porce, 7°28'N, 74°54'W, 1020 m (N.W. Weber) [MCZC]. COSTA RICA: *Alajuela:* 11 mi. N Florencia, 10°31'N, 84°29'W (D.H. Janzen) [USNM]; *Heredia:* La Selva Biological Station, 10°26'N, 84°01'W, 50 m (ALAS) [JNBC, JTLC]; same data (J. Longino) [JNBC, JTLC]; *Limón:* Hitoy Cerere Biol. Reserve, 9°40'N, 83°02'W, 100 m (J. Longino) [JTLC]; Los Diamantes, 10°13'N, 83°45'W (F.S. Truxal) [LACM]. ECUADOR: *Guayas:* Cerro Blanco, 15 km W. Guayaquil, 2°10'S, 80°02'W, 400 m (P.S. Ward) [JTLC, LACM]; *Los Rios:* Jauneche, 19 km WSW Mocache, 1°14'S, 79°40'W, 60 m (P.S. Ward) [JTLC, LACM]. GUYANA: New River, 3°23'N, 57°36'W (J. Myers) [MCZC]; Kartabo, 6°23'N, 58°41'W (W.M. Wheeler) [LACM, MCZC]; Demerara River Bank, 1 mi. from Georgetown, 6°48'N, 58°10'W, 22 Sep 1918 (H. Morrison) [USNM];

Kassikeityu River, 1°50′N, 58°33′W (J.G. Myers) [MCZC]. PANAMA: *Canal Zone*: Pipeline Road (Montgomery and Lubin) [LACM]. PERU: *Madre de Dios*: Tambopata, 12°50′S, 69°20′W, 290 m (T.L. Erwin) [LACM]; *San Martin*: Tarapoto, 6°29′S, 76°22′W, 350 m (P.S. Ward) [PSWC]. TRINIDAD: nr. Rio Claro, 10°18′N, 61°11′W (N.W. Weber) [MCZC]. VENEZUELA: no specific locality (Anduze) [MCZC]; *Bolivar*: 49 km ENE Tumeremo, 7°28′N, 61°06′W, 200 m (P.S. Ward) [PSWC].

Procryptocerus scabriusculus Forel, 1899

Figs. 1D, 3A,B

Procryptocerus adlerzi: Emery (*nec* Mayr) 1890:55 (misidentified worker: Costa Rica, Palmares).

Procryptocerus striatus schmalzi var. *scabriusculus* Emery, 1894:198. Holotype worker: Costa Rica, Palmares [10°03′N, 84°26′W] (Alfaro) [MCSN] (examined) (unavailable quadrinomial).

Procryptocerus striatus scabriusculus Forel, 1899:45 (first available use).

Procryptocerus scabriusculus: Kempf, 1951:89–93, fig. 88; Snelling, 1968:1–4, fig. 1 (description of male).

RANGE. Mexico to Venezuela.

DESCRIPTION OF WORKER. Worker measurements (n = 1, Costa Rica): HW 1.286, HL 1.163, SL 0.768, EL 0.306, MeL 1.503, MeW 0.955, PrW 0.679, PrL 0.307, PrS 0.298, PrT 0.606, MTL 0.827, MFL 0.911, MFW 0.339, PtL 0.434, PtW 0.431, PpW 0.549, PtH 0.395, AL 1.459, AW 1.173, ASW 0.018.

Head subcircular; vertex flat, sharply differentiated from face by vertex margin, which is entire and somewhat crenate; face evenly convex; in lateral view, anterior portion of clypeus curves ventrad, more strongly curved than general curvature of face and posterior clypeus; frontal carina thickened and laterally flattened just posterior to torulus, ending on dorsum of torulus; vertex shiny, with thin, widely spaced, somewhat irregular, and at times nearly absent longitudinal rugae (Central America, Colombia) or with dense, regular, pronounced longitudinal striae (Venezuela); face sculpture dominated by irregular shallow striae, with foveae not clearly formed and, if present, relatively large (Central America), or striae on the face thickened and nearly fused, isolating smaller, well-formed, teardrop-shaped foveae, and the areolate microsculpture more pronounced, giving the face a granular, less shiny appearance (Colombia, Venezuela); clypeus irregularly longitudinally striate with a few arcing transverse striae at anterior border; genae foveate; mandibles coarsely longitudinally striate; undersurface of head longitudinally striate; scapes with a flanged skirt at base, partially covering neck and condyle; scape weakly flattened, curving and gradually widening distally; scape finely and superficially microareolate dorsally, coarsely rugose on anterior edge; eyes in anterior view convex, asymmetrically skewed ventrally.

Promesonotum in dorsal view with rounded anterior margin, straight to weakly convex sides which converge to base of propodeum; humeri forming obtuse to subacute angles; lateral lobes of mesonotum not or only weakly elevated or projecting, usually approximating right angles aligned with the body axis; anterior border of pronotum with row of coarse foveae, rest of promesonotum and dorsal face of propodeum longitudinally striate; dorsal face of propodeum with produced lateral lobes which extend about half to two-thirds the length of the dorsal face; lateral lobes rounded posteriorly; propodeal spines generally subequal in length to dorsal face, but varying from shorter to longer; dorsal face of propodeum curving into approximately perpendicular posterior face, dorsal striae extend about halfway down posterior face, rest smooth and shining; in lateral view, promesonotum evenly convex; propodeal suture shallow; sides of pronotum flat, meeting dorsal face at distinct angle; lateral face pronotum, anepisternum, katepisternum, and lower portion of lateral face of propodeum with coarse longitudinal striae; femora strongly swollen, spindle-shaped; exterior surfaces of tibiae coarsely rugose; posterior face of forefemur smooth and shining or weakly striate.

Petiole short and squat, anterior face coarsely transversely rugose (smooth in some Mexican specimens); posterior face and dorsum of postpetiole irregularly longitudinally striate; first gastral tergite longitudinally striate throughout; interspaces microareolate, giving a subopaque or granular appearance to gaster; longitudinal striae usually do not or only weakly extend onto second gastral tergite; first gastral sternite subopaque to somewhat shiny with uniformly distributed small puncta, grading to patches of longitudinal rugulae or striae anterolaterally.

Face, dorsum of mesosoma, petiole, postpetiole, and gaster with sparse, short, erect to suberect setae; setae relatively longer and more abundant on petiole, postpetiole, and anterior portion of gaster; setae stiff but not strongly flattened.

The worker is also thoroughly described by Kempf (1951).

DESCRIPTION OF QUEEN. Queen measurements (n = 1, Costa Rica, LACM ENT 140413): HW 1.205, HL 1.146, SL 0.742, EL 0.392, MeL 1.943, MeW 1.104, MTL 0.867, MFL 0.973, MFW 0.308, PrL 0.512, PrW 0.443, PpW 0.585, PtH 0.431, AL 1.709, AW 1.335.

Similar to worker in most respects; face relatively more foveate and less distinctly striate; foveae relatively large and nearly confluent in Mexican specimens, smaller and interspaces more strialike in Costa Rican specimens, foveae very small and interspaces smooth with microareolate sculpture in Colombian specimens; pronotum coarsely foveate; mesoscutum, axillae, and scutellum with elongate foveae; dorsal face of propodeum longitudinally to obliquely striate.

See Kempf (1951) for a full description.

COMMENTS. Multiple collections from each region reveal little within-region variation, and the shared characters (face sculpture for Venezuela and Colombia, vertex sculpture for Colombia and Cen-

tral America) are quite consistent. Whether these are three allopatric lineages or points along a continuum of geographic variation is unknown. A possible phylogeny is (Central America [Colombia, Venezuela]), with the face sculpture common to Colombia and Venezuela being apomorphic, and the vertex sculpture in Venezuela being autapomorphic.

The male is thoroughly described by Snelling (1968).

BIOLOGY. *Procryptocerus scabriusculus* is the most frequently encountered species of *Procryptocerus* in Central America. Unlike most species, *P. scabriusculus* is most often found in dry habitats, roadsides, and second growth vegetation. Nest sites appear to be ephemeral, mostly in dead stems (records include stems of *Acacia*, *Spilanthes* and *Baccharis trinervia*), although nests have been found in live stems. A Creighton collection from Mexico was "in *Cecropia*," presumably an opportunistic occurrence in a sapling. Many of the specimens at USNM were on orchid plants intercepted by inspectors at U.S. entry ports. The orchids were most often *Oncidium* and *Cattleya*, but this probably reflects the preferences of orchid enthusiasts rather than the preferences of *P. scabriusculus*. Skwarra (1934) describes five colonies, three of which were in dead wood, one in hollow twigs, and one in a reed (from Kempf, 1951).

Wheeler (1984) observed the behavioral repertoire of a captive colony of *P. scabriusculus* and used the results to discuss the phylogenetic significance of behavioral traits within the Cephalotini. The study took place in central Costa Rica, and in the course of the study, four colonies were examined. At least one of the colonies was polydomous, in a cluster of twigs from a *Spondias* tree, and three colonies were polygynous, with up to 27% of the adult population composed of queens. Longino has observed both monogynous nests and one polygynous nest (with three dealate queens) near Monteverde, Costa Rica.

Workers forage at dusk, nocturnally, or both; queens and males occur at lights at night, and sexuals have been observed leaving the nest at night (Snelling, 1968). Ward collected alate queens and males at lights at Los Tuxtlas, Mexico.

ADDITIONAL MATERIAL EXAMINED. COLOMBIA: Bogota, 4°36'N, 74°05'W (Lindig) [NMW, misidentified as *P. adlerzi*]; no specific locality (Seattle Quarantine) [USNM]; same data (Hoboken Quarantine) [USNM]; *Cauca*: 15 mi. S Corinto, 2°54'N, 76°16'W, 1140 m (Schlinger and Ross) [LACM]; Calibio, 2°30'N, 76°33'W, 1850 m (A.J. Negrett) [MZSP]; *Cundinamarca*: La Esperanza, 12.50 m (René Rohá) [MCZC, USNM]; *Huila*: Pitalito (W.P. Mackay) [JTLC]; *Risaralda*: Pereira, 4°49'N, 75°42'W, 1000 m (A.J. Negrett) [MZSP]; La Virginia Miralindo, 1900 m (L.A. Osorio) [JTLC]; *Tolima*: 10 mi. E Ibague, 4°26'N, 75°07'W, 790 m (Schlinger and Ross) [LACM]; *Valle*: R.N. Lago de Sonso, 970 m (R. Aldana) [CFFC]. COSTA RICA: *Guanacaste*: Estacion Maritza, Guanacaste Conservation Area, 10°58'N, 85°30'W, 600 m (INBio) [INBC]; same data (J. Longino) [JTLC]; *Puntarenas*: Ojo de Agua, rd. to Monteverde, 10°16'N, 84°50'W, 800 m (J. Longino) [JTLC, LACM]; Wilson Botanical Garden, 4 km S San Vito, 8°47'N, 82°58'W, 1200 m (D.H. Janzen) [FSCA, LACM]; same data (J. Longino) [JTLC]; Bajo Tigre, Monteverde, 10°18'N, 84°49'W, 1200 m (J. Longino) [JTLC]; 5 km SW Las Alturas, 8°55'N, 82°52'W, 1240 m (P.S. Ward) [JTLC]; same data (J. Longino) [JTLC]; 5 km N Ciudad Neily, 8°42'N, 82°57'W, 780 m (P.S. Ward) [PSWC]; 6 km S Monteverde, 10°15'N, 84°49'W, 800 m (J. Longino) [JTLC]; *San José*: San José, 9°56'N, 84°05'W (W.M. Wheeler) [LACM, MCZC]; same data (D.E. Wheeler) [MCZC]; Alfombra, 9°19'N, 83°47'W, 850 m (P.S. Ward) [PSWC]; San Gerardo, 9°28'N, 83°36'W, 1280m (P.S. Ward) [PSWC]; 1km N La Ese, 9°27'N, 83°43'W, 1400m (P.S. Ward) [PSWC]; San Antonio de Escazu, 9°53'N, 84°07'W, 1300m (W. Eberhard) [MUCR]. EL SALVADOR: Los Chorros, 13°53'N, 89°27'W (Cavagnaro, Irwin) [LACM]; San Salvador, 13°42'N, 89°12'W (P.A.Berry) [USNM]; same data (O.L. Cartwright) [USNM]; Santa Tecla, 13°41'N, 89°17'W (L.J. Bottimer) [USNM]. GUATEMALA: Mocá, 14°32'N, 91°15'W (W.M. Wheeler) [MCZC]; no specific locality (San Francisco quarantine) [LACM, USNM]; same data (Los Angeles quarantine) [LACM]; *Alta Vera Paz*: Cacao, Trece Aguas, 15°24'N, 89°45'W (Barber and Schwarz) [USNM]; *Guatemala*: Guatemala City, 14°38'N, 90°31'W (San Francisco Quarantine) [LACM]; *Petén*: San Luis Las Cañas, 16°03'N, 89°21'W (T.W. Taylor) [male, probably *P. scabriusculus*] [LACM]; *Sacatepequez*: Antigua, 14°34'N, 90°44'W (W.M. Mann) [USNM]. HONDURAS: *Atlántida*: La Ceiba, 15°47'N, 86°48'W (Dole-APHIS insect survey) [LACM, USNM]. MEXICO: no specific locality (Brownsville, Texas quarantine) [USNM]; *Chiapas*: Ocosingo, Laguna Ocotal Grande, 17°04'N, 92°15'W, 950m (R.L. Dressler) [MCZC]; Ixtapa, 16°48'N, 92°55'W (F.D. Parker) [LACM]; junction of highway 190 and 195 (Ginter Ekis) [USNM]; Finca Esmeralda (R. Nettel F.) [MZSP, USNM]; Finca El Retiro (R. Nettel F.) [USNM]; Izapa, 14°58'N, 92°11'W (unknown) [MZSP]; *Colima*: 16km NNE Comala, 19°28'N, 103°42'W, 1280m (P.S. Ward) [PSWC]; *Navarit*: 9mi. N Compostela, 21°22'N, 104°35'W (R.L. Westcott) [large series of males, assumed to be *P. scabriusculus*] [JTLC, LACM]; 18km SW Compostela, 21°06'N, 105°03'W, (M.E. and D.D. Berkin) [USNM]; *San Luis Potosí*: Xilitla, 21°05'N, 98°59'W, 350m (W.S. Creighton) [LACM]; 22mi. E Ciudad del Maiz, 22°24'N, 99°16'W, 1000m (W.S. Creighton) [LACM]; *Tamaulipas*: Rancho Cielo, 12km NW Gomez Farias, 23°08'N, 99°14'W, 900m (P.S. Ward) [PSWC]; *Veracruz*: Santa Lucrecia, 17°26'N, 95°02'W (Fred K. Knabi) [MCZC]; same data (W.M. Mann) [USNM]; Las Hamacas, 17km N Santiago Tuxtla, 18°38'N, 95°18'W (E.O. Wilson) [MCZC]; Mirador, 19°13'N, 96°51'W (E. Skwarra) [MCZC]; Fortin, 18°54'N, 97°00'W, 950m (P.S. Ward) [PSWC]; 2mi. N Fortin de las Flores, 18°54'N, 97°00'W (D. H. Janzen) [USNM]; Los Tuxtlas, 10km NNW Sontecomapan, 18°35'N, 95°05'W, 200m (P. S. Ward) [PSWC]; same data (H. Hespenheide) [LACM]; same data, except 500 m (P.S. Ward) [PSWC]; Lag. Catemaco, 18°25'N, 95°07'W (Fisher and Verity) [LACM]; same data (Fisher and Sullivan) [LACM]; Cordoba, 18°53'N, 96°56'W (Fred K. Knabi) [MCZC]; same data (A.B. Lau) [USNM]; same data (R.R. Snelling) [LACM]. VENEZUELA: no specific locality (U.S. quarantine) [USNM]; same data (Hoboken Quarantine) [USNM]; same data (Seattle Quarantine) [USNM]; *Lara*: 5 km SE Barbacoas, 9°48'N, 70°01'W, 1500 m (J.

Longino) [LACM]; same data (P.S. Ward) [PSWC]; *Miranda:* 2 km S Baruta, 10°25'N, 66°53'W, 1200 m (C.R.F. Brandão) [MZSP]; Caracas, 10°30'N, 66°55'W (Hoboken Quarantine) [USNM]; same data (San Francisco Quarantine) [LACM]; *Monagas:* El Guacharo National Park, 10°09'N, 63°32'W, 1150 m (Cancello and Brandão) [MZSP]; *Trujillo:* Guaramacal, 13 km ESE Boconó, 9°11'N, 70°09'W, 1160 m (J. Longino) [JTLC, LACM]; same data (P.S. Ward) [PSWC].

Procryptocerus schmitti Forel, 1901

Procryptocerus schmitti Forel, 1901:338–339. Holotype worker: Brazil, State of Ceará, Baturité [4°22'S, 38°52'W] (Schmitt) [MHNG] (examined). Kempf, 1951:39–42, fig. 76, 85, 90, 91 (description of nontype worker, queen, male).

RANGE. Venezuela, Brazil (Bahia, Pernambuco).

COMMENTS. This species is very similar to *P. coriurius*, with which it is parapatric. See discussion under *P. coriurius*.

ADDITIONAL MATERIAL EXAMINED. BRAZIL: *Bahia:* Unacau, Una, 15°18'S, 39°04'W (J. Ricardo) [CPDC]; Faz. Nazaré, Itajuipe, 14°41'S, 39°22'W (F.P. Benton) [CPDC]; Faz. Guanabara, Mucuri, 18°05'S, 39°34'W (F.P. Benton) [CPDC]; EMARC, Uruçuca, 14°35'S, 39°16'W (B. Santos) [CPDC]; *Pernambuco:* Caruaru, 8°17'S, 35°58'W (O.S.B. Pickel) [MCZC, MZSP, USNM]; Recife, 8°03'S, 34°54'W (L. Lima Castro) [LACM, MCZC, MZSP]. VENEZUELA: *Monagas:* El Guacharo National Park, 10°09'N, 63°32'W, 1150 m (Cancello and Brandão) [MZSP]; *Sucre:* El Rincón, 30 km S Carupano, 10°36'N, 63°12'W (Cancello and Brandão) [MZSP]; *Trujillo:* 16 km ESE Boconó, 9°12'N, 70°08'W, 1040 m (P.S. Ward) [JTLC, PSWC].

Procryptocerus subpilosus (F. Smith, 1860)

Meranoplus subpilosus F. Smith, 1860:78. Syntype workers: Brasil, Amazonas: Ega (= Tefé) (H.W. Bates) [BMNH] (examined).
Catulacus subpilosus: Mayr, 1886:361.
Procryptocerus subpilosus: Emery, 1887:470; Kempf, 1951:60–61; Kempf, 1964a:435–436.

RANGE. Brazil (Amapá, Amazonas, Bahia, Mato Grosso, Pará, Rondonia), Ecuador, Guyana, Peru, Trinidad.

DESCRIPTION OF WORKER. Worker measurements (n = 1, Brazil, Benjamin Constant): HW 1.278, HL 1.222, SL 0.665, EL 0.305, MeL 1.507, MeW 0.889, PrW 0.692, PrL 0.434, PrS 0.242, PrT 0.676, MTL 0.805, MFL 0.841, MFW 0.317, PtL 0.489, PtW 0.370, PpW 0.477, PtH 0.371, AL 1.440, AW 1.177.

Similar to *P. impressus*, *P. paleatus*, and *P. tortugueros*; differing in the following combination of characters: face very shallowly sculptured, irregular longitudinal rugae usually absent or barely visible; foveae small and shallow, becoming increasingly effaced anteriorly; clypeus with faint longitudinal striae; clypeus and interspaces on frons sericous, with silky luster; vertex relatively more concave and meeting face at more acute angle than other species; mesonotum not strongly sloping; propodeal suture moderately impressed; lateral lobes of mesonotum angulate, projecting, but not concealing propodeal suture in side view; posterior face of forefemur completely smooth and shining; petiole elongate (PtL/PtH 1.3 versus 1.2 or less in the other species); first gastral tergite longitudinally striate, striae usually slightly irregular, anastomosing, gradually fading posteriorly, with posterior 0.06 mm smooth and shining (Vilhena specimen with more regular, pronounced striae on first gastral tergite); microareolate sculpture between striae, giving a granular appearance to gaster; first gastral sternite anterolaterally striate, strongly shining elsewhere; disc of face with two very short setae centrally, a longer pair near occipital border, otherwise devoid of setae; variably flattened, moderately abundant setae evenly dispersed on dorsum of mesosoma, petiole, postpetiole, and first gastral tergite; setae on first gastral tergite which lie on the same longitudinal line barely overlap.

DESCRIPTION OF QUEEN. Based on one alate queen from Kartabo, Guyana. Queen measurements (n = 1, Guyana, barcode: LACM ENT 144271): HW 1.391, HL 1.314, SL 0.694, EL 0.352, MeL 1.960, MeW 1.160, MTL 0.901, PtL 0.587, PrW 0.421, PpW 0.568, AL 1.780, AW 1.398.

Similar to worker in most respects; face as in worker; pronotum closely foveate laterally, each fovea with stiff, flattened seta; fovea density lower medially, with broad interspaces, with a few large foveae scattered across medial pronotum; mesoscutum, axillae, and scutellum with a mixture of elongate foveae and longitudinal striae; relatively sparse setae on mesoscutum, axillae, and scutellum; dorsal face of propodeum longitudinally striate.

ADDITIONAL MATERIAL EXAMINED. BRAZIL: *Amapá:* Rio Amapari, km 185 (J. Lane) [MZSP]; *Amazonas:* Rio Tarumã Mirim, 3°02'S, 60°17'W (J. Adis) [LACM]; Benjamin Constant, 4°22'S, 70°02'W (W.L. Brown, Jr.) [MCZC]; Manaus, 3°07'S, 60°02'W (K. Lenko) [MZSP]; *Bahia:* Camacã, 15°24'S, 39°30'W (F. Benton) [CPDC]; Mascote, 15°33'S, 39°17'W (F. Benton) [CPDC]; *Mato Grosso:* Sinop, 12°31'S, 55°37'W (M. Alvarenga) [MZSP]; Vila Vera, 12°18'S, 55°20'W (M. Alvarenga) [MZSP]; *Pará:* Utinga tract, near Belem, 1°27'S, 48°29'W (P.E. Darlington) [MCZC]; Pará, 1°27'S, 48°29'W (collector unknown) [MCSN]; same data (Goldi) [MHNG, identified as *P. attenuatus*]; *Rondonia:* Vilhena, 12°43'S, 60°07'W (M. Alvarenga) [MZSP]. ECUADOR: *Napo:* Jatun Sacha, 7 km ESE Peo. Misahuallí, 1°04'S, 77°37'W, 400 m (P.S. Ward) [JTLC]. GUYANA: Kartabo, 6°23'N, 58°41'W (W.M. Wheeler) [MCZC]. PERU: *Loreto:* 15 km WSW Yurimaguas, 5°59'S, 76°13'W, 200 m (P.S. Ward) [JTLC]; Yanamono Lodge, Quebrada Yanamono, 3°22'S, 72°47'W (H.A. Hespenheide) [LACM]; Amazon Safari Camp, Rio Mamón, NNW Iquitos, 3°42'S, 73°14'W (H.A. Hespenheide) [LACM]. TRINIDAD: no specific locality (N.A. Weber) [MCZC].

Procryptocerus tortugueros Longino and Snelling new species

Fig. 1F

Procryptocerus paleatus (part): Kempf, 1951:53–55, fig. 1, 20, 50, 67 (nec Emery) (description of worker: Costa Rica, Zent [Mann], misidentified as *P. paleatus*).

HOLOTYPE WORKER. Costa Rica, Prov. Limon, Tortuguero, 10°32'N 83°31'W, <5 m, 1–5 Jul 1985 (Longino #3821 [INBC]. Barcode: LACM ENT 141741.

PARATYPES. All from same nest series as holotype. One alate queen, LACM ENT 141766 [INBC]; one worker and one dealate queen, LACM ENT 141755 [LACM]; two workers, LACM ENT 141765 [BMNH]; two workers, LACM ENT 140647 [CPDC]; two workers, LACM ENT 141742 [MCZC]; two workers, LACM ENT 141743 [MHNG]; two workers, LACM ENT 141744 [MZSP]; two workers, LACM ENT 141745 [NHMB]; two workers, LACM ENT 141746 [PSWC]; two workers, LACM ENT 141747 [USNM]; two workers, LACM ENT 141748 [JTLC]; two workers, LACM ENT 141749 [CHAH].

RANGE. Costa Rica.

ETYMOLOGY. This species is named for the type locality. It is a noun in apposition, and thus invariant.

DESCRIPTION OF WORKER. Holotype worker measurements: HW 1.615, HL 1.462, SL 0.812, EL 0.365, MeL 1.821, MeW 1.165, PrW 0.812, PrL 0.552, PrS 0.236, PrT 0.787, MTL 1.015, PtL 0.555, PtW 0.457, PpW 0.592, PtH 0.452, AL 1.821, AW 1.510, ASW 0.041.

Similar to *P. impressus*, *P. paleatus*, and *P. subpilosus*; entire disc of the face with evenly dispersed erect setae; face sculpture, head shape, mesosomal profile, mesonotal teeth, propodeal suture, mesosomal sculpture, petiole shape and sculpture, and postpetiole shape and sculpture similar to *P. paleatus*; striae on the first gastral tergite fade out distally and posteriorly, similar to *P. subpilosus*; density of pilosity on gaster intermediate between *P. impressus* and *P. paleatus*, setae aligned on longitudinal axis subcontiguous, not or barely overlapping, but not as widely spaced as on *P. paleatus*.

Kempf (1951:53), identifying the series from Zent as *P. paleatus*, thoroughly described the worker.

DESCRIPTION OF QUEEN. Measurements of paratype queen (LACM ENT 141766): HW 1.572, HL 1.469, SL 0.810, EL 0.375, MeL 1.958, MeW 1.239, MTL 1.041, MFL 1.092, MFW 0.383, PtL 0.613, PtW 0.429, PpW 0.575, PtH 0.455, AL 1.977, AW 1.560.

Shape, sculpture, and pilosity as in worker, except for mesosomal characters typical of caste; pronotum with coarse piligerous foveae, confluent laterally and posteriorly, smaller and separated by broad interspaces anteromedially; mesoscutum, axillae, and scutellum with mixture of longitudinal rugae and elongate piligerous foveae; dorsal face of propodeum with longitudinal, vermiculate rugae; wings smoky brown.

BIOLOGY. The nest series from which the holotype was selected was collected from lowland rainforest. The nest was in a trailside woody plant stem whose apex was an old machete cut. The ants inhabited the dead terminus of the branch, just distal to the live portion. The live stem was solid, and the ants were in chambers excavated either by themselves or by a previous stem-boring insect. The entire nest was sampled and contained 108 workers, one dealate queen, one alate queen, and brood. The other specimens from the type locality were collected from low vegetation. The worker from below Volcán Barba was collected from the canopy of primary rainforest, approximately 20 m high. Workers from 17 km south of Puerto Viejo were in the crown of a recent treefall in primary wet forest.

ADDITIONAL MATERIAL EXAMINED. Costa Rica: *Heredia*: same data as holotype (Longino #389-s) [LACM]; 22 km N Volcán Barba, 10°20'N, 84°04'W, 500 m (Longino #240-s) [LACM]; 17 km S Puerto Viejo, 10°18'N, 84°02'W, 600 m (Longino #1069-s) [LACM]; *Limón*: Zent, 10°02'N, 83°17'W (W.M. Mann) [USNM] (series misidentified by Kempf as *P. paleatus*; three males with same data and three unlabeled workers are probably part of the same Mann series).

ACKNOWLEDGMENTS

The following curators were very helpful in the loan of specimens and during museum visits: C. Besuchet, D. Burckhardt, and I. Löbl (MHNG); V. Rainieri (MCSN); S. Cover (MCZC); D. Smith (USNM); R. Brandão (MZSP); and P. Ward (U.C. Davis). The manuscript was greatly improved from editorial comments by R. Brandão and P.S. Ward. This work has been supported by National Science Foundation grants BSR-9025024, DEB-9401069, and DEB-9706976.

LITERATURE CITED

Andrade, M. L. de, and C. Baroni Urbani. 1999. Diversity and adaptation in the ant genus *Cephalotes*, past and present (Hymenoptera, Formicidae). *Stuttgarter Beiträge zur Naturkunde Serie B (Geologie und Paläontologie)* 271:1–889.

Bolton, B. 1994. *Identification guide to the ant genera of the world*. Cambridge, Massachusetts: Harvard University Press, 222 pp.

Brown, W. L., Jr. 1973. A comparison of the Hylean and Congo–West African rain forest ant fauna. In: *Tropical forest ecosystems: A comparative review*, eds. B. J. Meggers, E. S. Ayensu, and W. D. Duckworth, 161–185. Washington, D.C.: Smithsonian Institution Press.

Colwell, R. K. 1996. *Biota: The biodiversity database manager*. Sunderland, Massachusetts: Sinauer Associates, 574 pp.

Emery, C. 1887. Catalogo delle formiche esistenti nelle collezioni del Museo Civico di Genova. Parte terza. Formiche della regione Indo-Malese e dell'Australia. *Annali del Museo Civico di Storia Naturale di Giacomo Doria* (2)4:209–258, 3 figures, 2 plates; 5: 427–473, 2 plates.

———. 1890. Studii sulle formiche della fauna neotropica. I–V. *Bollettino della Società Entomologica Italiana* 22:38–80.

———. 1894. Studi sulle formiche della fauna neotropica. VI–XVI. *Bollettino della Società Entomologica Italiana* 26:137–241.

———. 1896. Studi sulle formiche della fauna neotropica. XVII–XXV. *Bollettino della Società Entomologica Italiana* 28:33–107.

———. 1924(1922). Hymenoptera. Fam. Formicidae. Subfam. Myrmicinae. [concl.] In: *Genera Insectorum*, ed. P. Wytsman, Fasc. 174C, 207–397.

Forel, A. 1899. *Formicidae. Biologia Centrali-Americana, Hymenoptera* 3:1–160.

———. 1901. Varietes myrmécologiques. *Annales de la Société Entomologique de Belgique* 45:334–382.

———. 1904. Miscellanea myrmécologiques. *Revue Suisse de Zoologie* 12:1–52.

———. 1907. Formicides du Musee National Hongrois. *Annales Historico-Naturales Musei Nationalis Hungarici* 5:1–42.

———. 1911. Die Ameisen des K. Zoologischen Museums in München. *Sitzungsberichte der Bayerischen Akademie der Wissenschaften zu München* 11:249–303.

———. 1912. Formicides néotropiques. Part II. 3 sous-famille Myrmicinae Lep. (Attini, Dacetti, Cryptocerini). *Memoires de la Société R. Entomologique de Belgique* 19:179–209.

Gámez, R. 1991. Biodiversity conservation through facilitation of its sustainable use: Costa Rica's National Biodiversity Institute. *Trends in Ecology and Evolution* 6:377–378.

Harris, R. A. 1979. A glossary of surface sculpturing. *Occasional Papers in Entomology*, California Department of Food and Agriculture, vol. 28, 31.

Kempf, W. W. 1951. A taxonomic study on the ant tribe Cephalotini (Hymenoptera: Formicidae). *Revista de Entomologia* 22:1–244.

———. 1957. Sobre algumas espécies de *Procryptocerus* com a descrição de uma especie nova (Hymenoptera, Formicidae). *Revista Brasileira de Biologia* 17:395–404.

———. 1960. Miscellaneous studies on Neotropical ants (Hymenoptera, Formicidae). *Studia Entomologica* (n.s.)3:417–466.

———. 1964a(1963). Nota sinonimica acêrca de formigas da tribo Cephalotini (Hymenoptera, Formicidae). *Revista Brasileira de Biologia* 23:435–438.

———. 1964b. Additions to the knowledge of the Cephalotini ants (Hymenoptera, Formicidae). *Papéis Avulsos de Zoologia* 16:243–255.

———. 1969. Miscellaneous studies on neotropical ants. V. (Hymenoptera, Formicidae). *Studia Entomologica* 12:273–296.

———. 1973. A new *Zacryptocerus* from Brazil, with remarks on the generic classification of the tribe Cephalotini (Hymenoptera: Formicidae). *Studia Entomologica* 16:449–462.

Latreille, P. A. 1802. *Histoire naturelle générale et particulière des Crustacés et des insectes.* Tome 3. *Familles naturelles des genres.* Paris: F. Dufart, xii + 467 pp.

Mayr, G. 1870. Formicidae novogranadenses. *Sitzungsberichte der Akademie der Wissenschaften in Wien* 61:370–417.

———. 1886. Notizen über die Formiciden-Sammlung des British Museum in London. *Verhandlungen der Zoologisch-botanischen Gesellschaft in Wien* 36: 353–368.

Menozzi, C. 1935. Spedizione del Prof. Nello Beccari nella Guiana Britannica. Hymenoptera-Formicidae. *Redia* 21:189–203.

O'Hara, R. J. 1993. Systematic generalization, historical fate, and the species problem. *Systematic Biology* 42: 231–246.

Santschi, F. 1921. Ponerinae, Dorylinae et quelques autres formicides neotropiques. *Bulletin de la Société Vaudoise des Sciences Naturelles* 54:81–103.

Skwarra, E. 1934. *Ökologie Studien über Ameisen und Ameisenpflanzen in Mexiko.* Königsberg, 153 pp.

Smith, F. 1860. Descriptions of new genera and species of exotic Hymenoptera. *Journal of Entomology, London* 1:65–84.

———. 1876. Descriptions of new species of Cryptoceridae, belonging to the genera *Cryptocerus, Meranoplus,* and *Cataulacus. Transactions of the Royal Entomological Society of London* 1876:603–612.

Snelling, R. R. 1968. Taxonomic notes on some Mexican cephalotine ants (Hymenoptera: Formicidae). *Los Angeles County Museum, Contributions in Science* 132:1–10.

Weber, N. A. 1938. New ants from stomachs of *Bufo marinus* L. and *Typhlops reticulatus* (L). *Annals of the Entomological Society of America* 31:206–210.

Wheeler, D. E. 1984. Behavior of the ant, *Procryptocerus scabriusculus* (Hymenoptera: Formicidae), with comparisons to other cephalotines. *Psyche* 91:171–192.

Wheeler, G. C., and J. Wheeler. 1954. The ant larvae of the myrmicine tribes Cataulacini and Cephalotini. *Journal of the Washington Academy of Science* 44: 149–157.

———. 1973. Ant larvae of four tribes, 2nd supplement. *Psyche* 80:70–82.

Wheeler, W. M. 1911. A list of the type species of the genera and subgenera of Formicidae. *Annals of the New York Academy of Sciences* 21:157–175.

Received 19 December 2000; accepted 16 August 2001.

NATURAL HISTORY MUSEUM
OF LOS ANGELES COUNTY
900 Exposition Boulevard
Los Angeles, California 90007