

## Digger Wasps of the Genus *Pisoxylon* (Hymenoptera, Sphecidae, Trypoxylini)

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**Abstract**—In a review of a Neotropical digger wasp genus *Pisoxylon* Menke, 1968, two new species (*P. amenkei* sp. n. and *P. roosevelti* sp. n.) and female of *P. xanthosoma* Menke, 1968 are described; a key to *Pisoxylon* species is provided. Interrelations between the closely related genera of the tribe Trypoxylini, *Pisoxylon* Menke and *Trypoxylon* Latreille are discussed.

The genus *Pisoxylon* Menke, 1968 was described from a male of a single species, *P. xanthosoma* Menke, 1968. Until recently, its position within the tribe Trypoxylini has raised no serious doubts, although already Menke (1968) emphasized that this genus is evidently closely related to *Trypoxylon* Latreille. Menke considered the compact abdomen as the only autapomorphy of *Pisoxylon*; even though some groups of species (e.g. *rufidens*) of the genus *Trypoxylon* may have shortened abdominal segment I, the abdomen of such species is noticeably elongate rather than compact and always possesses more or less developed constrictions between the segments.

However, after the description of *Trypoxylon mojuba* Amarante, 1995, with a non-elongate, as in *Pisoxylon*, segment I of the equally compact abdomen, it has become clear that the two genera in question cannot be unambiguously separated using this character only. According to Amarante (1995), *T. mojuba* additionally differs from *Pisoxylon* in the presence of a propodeal sternite and lateral propodeal carinae. However, the propodeal sternite (which in the species examined by the author of the present work is not actually a propodeal sclerite but a derivative of the intersegmental membrane, as indicated by the absence of associated muscles) is far from being present in all representatives of the nominotypical subgenus *Trypoxylon* (*Trypoxylon*). The structure is usually observed only in the species having strongly elongate abdominal segment I, being absent in all species belonging to *Trypoxylon* (*Trypargilum*). Similarly, lateral propodeal carinae are absent in many species of *Trypoxylon* (*Trypoxylon*) (e.g., in *petiolatum* and *fabricator* species groups) and in all representatives of the subgenus *Trypoxylon* (*Trypargilum*). Consequently,

the only character distinguishing *Pisoxylon* from *Trypoxylon* is the compact abdomen combined with the absence of a propodeal sternite and lateral propodeal carinae. In my opinion, this character appears to give insufficient support for the separate generic status of *Pisoxylon*, and I share the opinion of Amarante and Menke (pers. comm.), that all species currently placed in *Pisoxylon* may represent a well-outlined group (a subgenus or a species group) within the polymorphic genus *Trypoxylon*. At the same time, *P. roosevelti* sp. n. has a lamelliform upper margin of metapleura, which suggests that this species should be placed in a separate group; a similar situation is known in the genera *Pison* (e.g., *agile* species group) and *Trypoxylon* [e.g., *nitidum* species group within the subgenus *Trypoxylon* (*Trypargilum*) and *fabricator* species group within the nominotypical subgenus]. However, it appears premature to change the *status quo* of the 2 genera without an up-to-date revision of the Neotropical species of *Trypoxylon*.

Biological data on *P. xanthosoma* (Morato and Campos, 1994) indicate that the nest structure, relative size of cells and cocoons of individuals of different sexes, and their arrangement within a linear nest are similar in *Pisoxylon* and *Trypoxylon* (*Trypoxylon*). This additionally supports the close relationship between the two genera.

The following abbreviations are used below: *HH* : *HW* : *HL*, ratio of maximum height of head to its width (in frontal view) and its length (in lateral view); *IOD*, ratio of minimum distance between inner eye orbits at the level of vertex to those measured at the level of apical eye emarginations and at the level of clypeus base; *OOD* : *Od* : *POD*, ratio of distance between

inner eye orbit (on vertex) and lateral ocellus to the lateral ocellus diameter and to distance between lateral ocelli;  $A3 : AW$ , ratio of maximum length of 3rd antennal segment to its maximum width at apex;  $d$ , distance between punctures;  $\emptyset$ , diameter of punctures. The number of hind-wing hooks is given in groups, counting from the wing base. The measurements are made at 50 $\times$  magnification.

### GENUS *PISOXYLON* MENKE, 1968

*Pisoxylon* Menke, 1968: 1. Type species: *Pisoxylon xanthosoma* Menke, 1968, by original designation. *Pisoxylon* Menke: Bohart, Menke, 1976: 338.

**Diagnosis.** Inner eye orbits not or slightly converging ventrally; frons moderately convex, ventrally with apical transverse carina and median entire or dorsally divided carina. Median clypeal lobe in female protrudes forward or bears short lamellar apical protrusion. Supraclypeal sclerite present; labrum small, with 2 narrow, digital apical lobes; mandibles have neither ventral incision (or tooth), nor inner tooth. Antennal segments unmodified, not club-shaped, becoming shorter toward apex of antenna. Occipital carina incomplete, not extending to hypostomal one. Pronotal ridge roundly transverse, without transverse carina and lateral corners, clearly bordered posteriorly. Mesonotum roundly convex, slightly raised above the level of pronotum, with well-developed admedial lines anteriorly, with or without traces of adlateral lines laterally; episternal suture present, ventrally smoothed; omaulus, subomaulus, hypersternaulus, and acetabular carina absent. Mesopleura ventro-anteriorly without lamellar margin; metapleura noticeably dilated dorsad. Propodeum moderately elongate-oval, without specific preapical structures; dorsal field not clearly outlined, with median groove; lateral carinae absent. Abdomen short, with non-elongate segment I. Tergite VI conical in dorsal view, without pygidial area, but with more or less distinct median costa at apex. Middle and hind coxae equally approximated; hind coxae with complete inner carina and without outer one; in female, without ventral organs. Legs in both sexes unmodified; tarsomeres ventrally without apical plantulae; arolia rather large; claws unmodified. Wings hyaline, not darkened; apex of marginal cell acute, lying at anterior wing margin; outer vein extends beyond outline of marginal cell; 1 submarginal and 1 discoid cell present; *cu-a* of fore wing antefurcal. Hind wing bears (or not) single basal hook and 2 groups of 5(6) + 3 hooks;

each, divided by glabrous part about twice as long as proximal group; intercalary hooks absent.

**Distribution.** Species of the genus *Pisoxylon* have been found exclusively in the central part of South America (Fig. 1).

**Biology.** Biological data on representatives of the genus *Pisoxylon* were reported in a single paper (Morato and Campos, 1994) mainly concerned with nest-building characteristics of *P. xanthosoma*.

Artificial nests in the form of sectional wooden blocks with longitudinal holes 4.8, 9.5, or 12.7 mm in diameter were fixed on trees in the rainforest, 70–90 km N of Manaus (Amazonas, Brazil). During a 2-year period, a total of 17 nests of *P. xanthosoma* were obtained, 4 of them built in 9.5-mm tunnels, and others in 4.8-mm ones (Morato and Campos, 1994).

Nests built by *P. xanthosoma* females consisted of 1–4 cells, arranged linearly and separated by clay septae 1 mm thick. In 6 nests of diameter 4.8 mm, the first septa at the nest entrance was built at an average distance of 24.4 mm from the bottom; no such septae were observed in nests built in 9.5-mm tunnels.

Five nests had a single intercalary cell, located between the brood cells; 2 nests contained 2 such cells each. One (in 11 nests) or 2 (in 2 nests) vestibular cells were present in front of the outer cover. Both intercalary and vestibular cells were found in nests of different diameters. In 5 nests, the last cell was sealed by 2 outer covers 1 mm thick, separated by a 1–2-mm interval. One nest contained even 3 outer covers lying 1 mm apart.

The average cell length was greater in 4.8-mm tunnels than in 9.5-mm ones (17.8 and 15.3 mm for female cells and 14.0 and 11.0 mm for male cells, respectively). The average cocoon length was greater in females than in males: 11.8 and 9.5 mm (nest diameter, 4.8 mm), and 12.3 and 10.0 mm (nest diameter, 9.5 mm); however, the cocoon length of a certain sex did not vary significantly in relation to the nest diameter. On the contrary, the average length of vestibular and intercalary cells was greater in 9.5-mm nests than in 4.8-mm ones (23.7 and 19.5 mm for vestibular cells and 24.5 and 11.7 mm for intercalary cells, respectively).

Of the 3 nests in which the individuals of both sexes developed, in 2 cases (with nest diameter of 4.8 mm and 9.5 mm) the female cells were located basally to

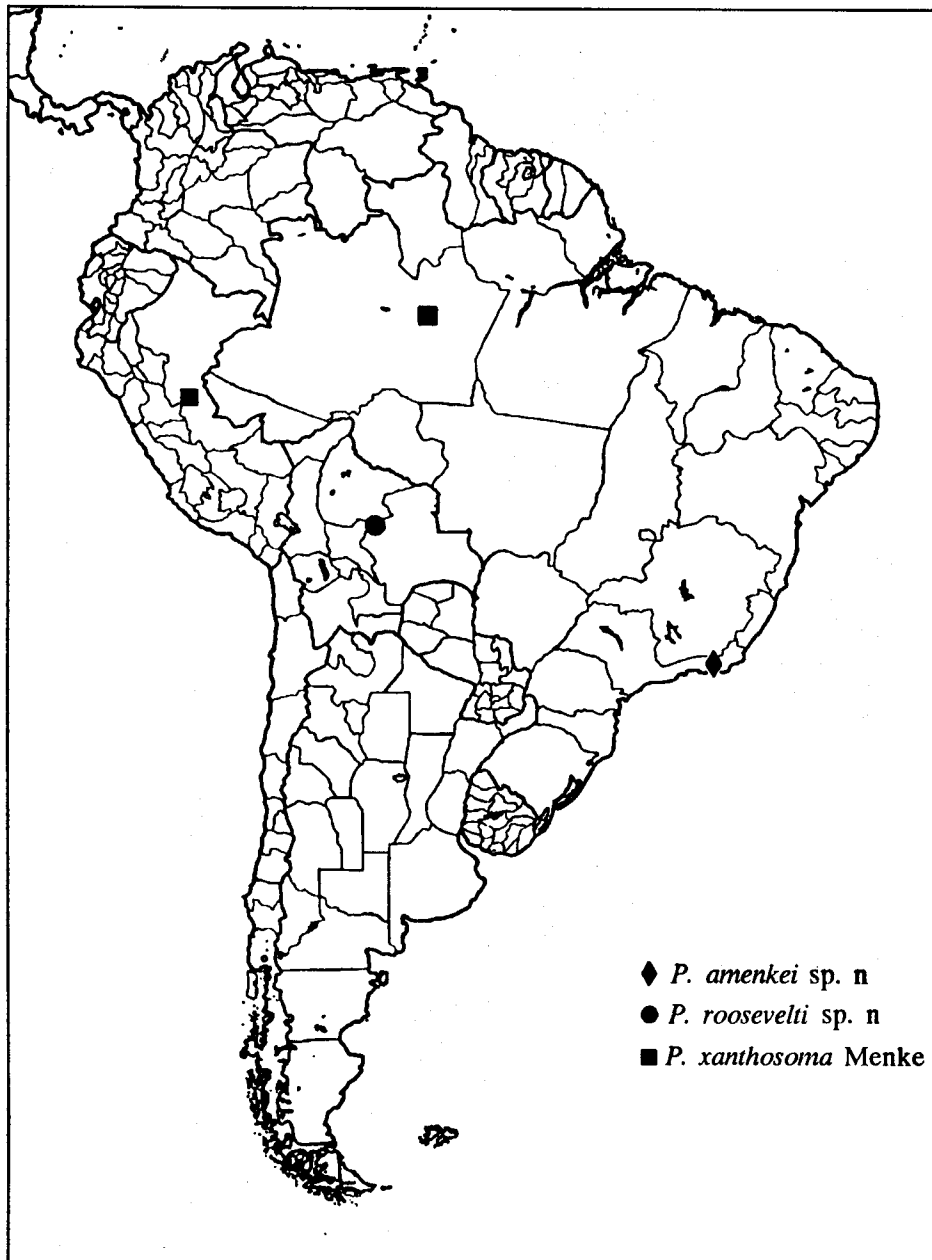


Fig. 1. Distribution of species of the genus *Pisoxylon*.

male ones. In one nest (4.8 mm in diameter), a male cell occupied the basal position, followed by an intercalary cell, a female cell, and a vestibular one.

The outer nest cover was located at an average distance of 19.3 mm (nest diameter, 4.8 mm) or 13.0 mm (nest diameter, 9.5 mm) from its outer margin.

In one case, a 9.5-mm nest, containing a single cell, was occupied by *Megachile* (*Austromegachile*) *orbiculata*. In another case, a puparium of Bombyliidae (Diptera) was found in the outer cell of a 9.5-mm nest.

Unfortunately, the paper of Morato and Campos (1994) provides no information about the prey and the preimaginal stages of *P. xanthosoma*, and primarily about the peculiarities of larval morphology and structure of cocoon walls and the position and orientation of cocoons in cells. However, the presented data indicate that nests of *P. xanthosoma* are undoubtedly similar to those of the nominotypical subgenus *Trypoxylon*. In general, *P. xanthosoma* is characterized by a xylicolic nest built in a preexistent hole, with linear arrangement of cells, outer cover located deep in the

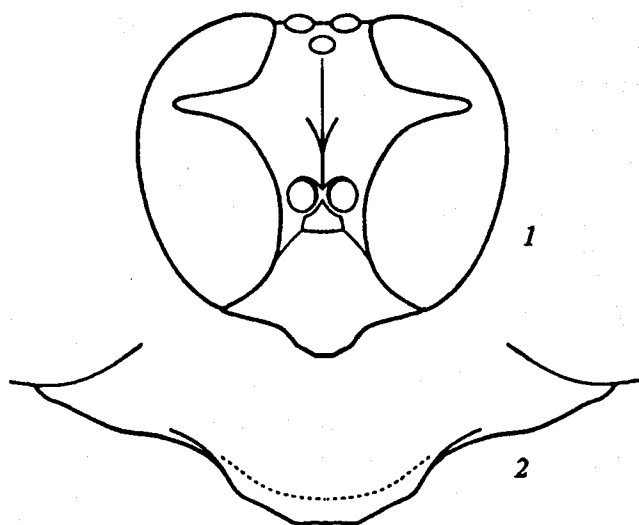


Fig. 2. Morphological details of a female of *Pisonotus amenkei* Antropov, sp. n. (1) Head and (2) clypeus in anterior view.

nest tunnel, and without a clay lining of the bottom of the first cell.

The available data are insufficient to conclude whether the nest of *P. xanthosoma* is obligatorily alldal, since the shape of all the examined nests was from the very beginning determined by that of the artificial tunnels. According to the author's data, some species of *Trypoxylon* (*Trypoxylon*), such as *T. regium* Gussakovskij and *T. rubiginosum* Gussakovskij, can build heterodal xylicolic nests when branching tunnels made by xylophages are available and females possess a sufficient reproductive potential; however, in this case, the position of the outer cover, typical of a particular species, remains unchanged. *P. xanthosoma*, like *Trypoxylon* (*Trypoxylon*), is characterized by a certain size ratio of male and female cells and cocoons, and also by mostly basal position of female cells (and, correspondingly, earlier eclosion of males). It is also difficult to decide whether first septae remote from the cavity bottom are typical of *P. xanthosoma*, since in both cases the diameters of inhabited nests were close to the limiting value for this species: the 4.8-mm tunnel is only slightly wider than the female head, and the 9.5-mm tunnel is only slightly narrower than its body length. The optimum tunnel size for nests of *P. xanthosoma* lies probably somewhere between the two values used. In the author's opinion, nest-building in 9.5-mm tunnels is more characteristic of *P. xanthosoma*, with narrower tunnels regarded by females as too long for their particular reproductive states. Ac-

cording to the author's data, this behavior is typical of females of some *Trypoxylon* (*Trypoxylon*) species, e.g., *T. koreanum* Tsuneki and *T. exiguum* Tsuneki, when the available tunnel is very long. Finally, it is hardly possible to determine the number of brood cells filled by a female of *P. xanthosoma* in nature, because the artificial nests used were not very deep; this number may quite probably be higher than 4.

*Pisonotus amenkei* Antropov, sp. n.

*Pisonotus xanthosoma* (?): Bohart, Menke, 1976: 338, ♀.

*Pisonotus xanthosoma*: Morato, Campos, 1994: 585, ♀.

**Material.** Holotype, ♀: "Petropolis Rio Brazil, Mar. 1938 (YelFevServ. MES Brazil, R.C. Shannon)" [USNM]. 8–12th segments of both antennae, 4–5th right middle tarsomeres, 2nd–5th right hind tarsomeres, and 4–5th left hind tarsomeres absent.

**Description. Female.** Head somewhat widened dorsally (in frontal view; Fig. 2, 1). Median clypeal lobe convex in the middle and strongly protruding, trapeziform; laterally with frontal depression and bent frontally along anterior margin (Fig. 2, 2). Supraclypeal sclerite not longer than its basal width; raised supraantennal field of lower part of frons bears apically a transverse angular carina connected with borders of antennal pits and median carina dorsally divided in 2 branches shorter than undivided part. Distinct groove extending as far as median ocellus and deepest anteriorly present between lateral branches of frontal carina. Upper part of frons convex laterally to median groove.  $HH : HW : HL = 109 : 116 : 62$ ;  $IOD = 30 : 94 : 26$ ;  $OOD : Od : POD = 3 : 10 : 6$ ;  $A3 : AW = 20 : 8$ .

Pronotal ridge transverse, medially oval-arched posteriad, clearly limbate posteriorly. Mesonotum with short admedial lines anteriorly and short but distinct traces of adlateral lines laterally. Mesopleura, scutellum, and postscutellum rounded and convex; metapleura flat, dilated dorsad but without lamellar dilation along dorsal margin. Fore coxae flatly depressed anteriorly. Hind wings bear 2 groups of 6 + 3 hooks each, separated by glabrous part nearly twice as long as proximal group.

Dorsal field of propodeum depressed medially; posterior side of propodeum with narrow median

groove, short of its apex. Abdominal tergite VI with median rib at apex.

Frons, vertex, pro- and mesonotum, and scutellum uniformly shagreened, dull; postscutellum finely punctate, smooth. Mesopleura with shallow punctation, denser ventrally, with punctures located at bases of hairs ( $d = 2-4 \text{ } \varnothing$ ) on shiny background. Dorsal field of propodeum with dense and uniform rugosity, longitudinal basally and oblique-transverse subapically. Posterior and lateral parts of propodeum with inconspicuous sparse punctures ( $d > 3 \text{ } \varnothing$ ) on shiny background. Abdominal tergites micro-punctate, semi-dull; abdominal sternites with smoothed transverse micro-striae and sparse irregular punctation.

Pubescence longest on clypeus, inner apical surface of fore coxae, and lateral parts of abdominal sternites. Pubescence of other body parts short, without golden tint, silver or brown (on frons, mesonotum, and scutellum); erect on propodeum, semi-recumbent on frons and thorax, and recumbent on temples and abdominal tergites.

General body coloration dark brown; base of mandibles, palps, fore coxae, postscutellum (except on sides), and median spot at base of abdominal tergite I yellow red. Apex of clypeus; scapes (entire ventral surface and basal  $\frac{4}{5}$  of dorsal surface); anterior and lateral parts of pronotum; humeral tubercles posteriorly; small spots on ventral and posterior surface of mesopleura and lateral surface of scutellum; tarsi and tibiae; ventral surface of fore femur; middle femur anteriorly and posteriorly; outer and inner surfaces of hind femur; outer surface of middle coxae; and apical borders of abdominal tergites I-V, all ginger-red.

Body length, 10 mm.

Male unknown.

**Differential diagnosis.** *P. amenkei* sp. n. resembles *P. xanthosoma* in having not dilated dorsal margin of metapleura; strongly protruding, trapeziform median clypeal lobe; short supraclypeal sclerite; dorsally divided median carina on lower part of frons; yellow postscutellum. The new species differs from *P. xanthosoma* in the shorter dorsal branches of the median carina of frons; noticeably greater value of  $OOD : Od$  ratio; fore coxae flat-depressed ventrally; brown general coloration of clypeus, mesothorax (except for postscutellum), and propodeum; and silver and brown pubescence of body.

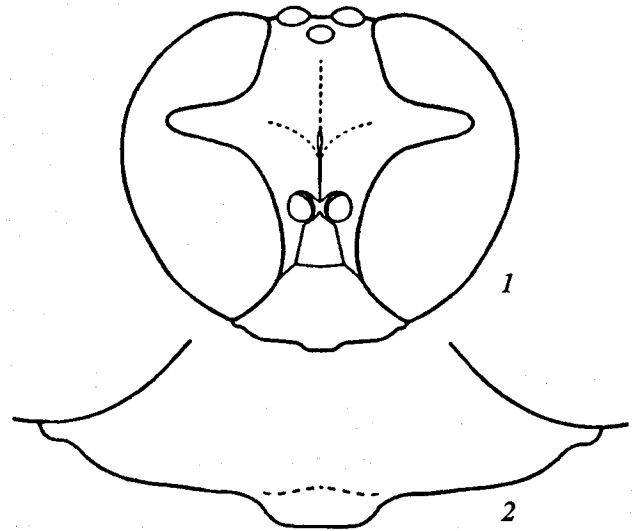


Fig. 3. Morphological details of a female of *Pisonoxylon roosevelti* Antropov, sp. n. (1) Head and (2) clypeus in anterior view.

**Etymology.** The species is named for Dr. Arnold S. Menke, one of the leading Sphecidae experts in the New World. I added the first letter of Dr. Menke's first name to the species name, to avoid the possible homonymy in case the genera *Pisonoxylon* and *Trypoxylon* are united in future.

*Pisonoxylon roosevelti* Antropov, sp. n.

**Material.** Holotype, ♀: "BOLIVIA: Dept. Santa Cruz, Rio Mamore, 2 km N of mouth of Rio Chapare, 31.VII.1965 (J.K. Bouseman)" [AMNH].

**Description. Female.** Head rounded in frontal view (Fig. 3, 1). Median clypeal lobe (Fig. 3, 2) flat, almost straight along anterior margin, with wide and short apical protrusion. Supraclypeal sclerite longer than its maximum basal width; raised supraantennal field of lower part of frons roof-shaped, with anterior obtuse transverse carina connected to borders of antennal pits; median carina on this field entire, strongly shining posteriorly, protruding as far as  $\frac{1}{3}$  the distance between its apex and median ocellus. Frons moderately (mainly in the middle) convex, with hardly visible median groove.  $HH : HW : HL = 78 : 91 : 47$ ;  $IOD = 23 : 72 : 15$ ;  $OOD : Od : POD = 2 : 8 : 5$ ;  $A3 : AW = 14 : 6$ . Pronotal ridge short, flattened medially, convex laterally, and broadly-limbate posteriorly. Mesonotum with short admedial lines anteriorly and without noticeable traces of adlateral lines. Scutellum flat-convex; postscutellum clearly convex; mesopleura moderately convex; metapleura flat, with hyaline

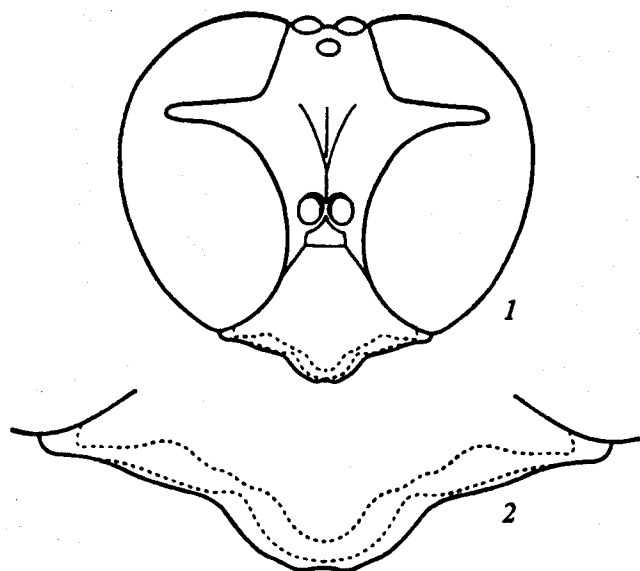


Fig. 4. Morphological details of a female of *Pisonoxylon xanthosoma* Menke. (1) Head and (2) clypeus in anterior view.

laminar dilation dorsally. Fore coxae convex anteriorly. Hind wings bear single basal hook and 2 groups of 5 + 3 hooks each, separated by glabrous part twice as long as proximal group. Dorsal field of propodeum not outlined, with median groove dilated posteriorly; posterior part of propodeum with deep median groove, short of its apex. Abdominal tergite VI conical, with smoothed median costa at apex.

Body sculpture poorly developed and smoothed, distinct only on head. Frons shagreened, with sparse shallow punctures ( $d \approx 2 \varnothing$ ), dull. Pronotum with fine transverse microstriae, shiny; mesonotum with hardly visible microstriae, shiny; scutellum with microstriae and sparse shallow punctures located at bases of hairs ( $d > 3 \varnothing$ ), shiny; postscutellum with fine transverse striae and punctures at hair bases, semi-dull; abdominal tergites and sternites with micropunctures at hair bases, shiny; tergite VI with longitudinal microstriae.

Pubescence of body sparse, silverish, not concealing sculpture. Hairs erect on frons and apex of propodeum, semi-recumbent on temples, pro- and mesonotum, scutellum, postscutellum, and basi-lateral parts of propodeum, and recumbent on mesopleura and abdominal segments I–V. Abdominal segment VI bears long sparse setae.

General body coloration black. Anterior half of clypeus (before apical rim) yellow-white; base of mandibles, apical rim of clypeus, and posterior part of hu-

meral tubercles red-yellow. Scapes, pedicels ventrally, tegulae, postero-ventral part of mesopleura (anteriorly to middle coxae), apical parts of fore and middle coxae, all trochanters, bases of fore femora, entire fore and middle tibiae, fore tarsi, and 1st hind tarsomere, all ginger-red. Basal parts of fore and middle coxae, lateral and ventral spots on abdominal segments I–II, apical rims of abdominal sternites I–V, and entire sternite VI red-brown.

Body length, 7.7 mm.

Male unknown.

**Differential diagnosis.** *P. roosevelti* sp. n. differs from its two congeners primarily in the laminar dilation of dorsal margin of metapleura, and also shorter and flatter median lobe of clypeus with short rectangular apical protrusion; longer supraclypeal sclerite; entire median carina on lower part of frons; less flattened head; entirely black mesothorax and propodeum, and smaller size.

**Etymology.** The species is named for Mr. Theodore Roosevelt, whose Fund supported the author's work at the American Museum of Natural History (AMNH).

*Pisonoxylon xanthosoma* Menke, 1968

*Pisonoxylon xanthosoma* Menke, 1968: 2. Holotype, ♂: Peru, Pucallpa, Loreto, 200 m, 10–19.IV.1965 (J. Schunke) [Los Angeles County Museum of Natural History].

*Pisonoxylon xanthosoma* Menke: Morato, Campos, 1994, ♀, ♂ (biology), Brazil.

**Material.** 1 ♂: "BRASIL, AM, Manaus, 10.XII.1989 (E.F. Morato)" [USNM].

**Female** (previously undescribed). Resembles female of *P. amenkei* sp. n. in appearance, differing primarily in amber-yellow thorax, legs, and abdomen. Head (Fig. 4, 1) slightly wider than in *P. amenkei* sp. n.; distance between inner eye orbits on vertex not longer than that at the level of clypeus. Inner eye emarginations noticeably narrower and longer; lateral ocelli almost touch inner eye orbits. In addition, branches of median carina of lower frons noticeably exceed in length its anterior undivided part, and considerably longer than those in *P. amenkei* sp. n. Clypeus with distinct white stripe along anterior margin (Fig. 4, 2). Supraclypeal sclerite no longer than its maximum basal width.  $HH : HW : HL = 107 : 118 : 63$ ;  $IOD = 24 : 95 : 23$ ;  $OOD : Od : POD = 1 : 10 : 4$ ;  $A3 :$

AW = 22 : 8. Mesonotum lacks adlateral lines. Metapleura dilated dorsad but without lamellar dilation of upper margin. Fore coxae convex ventrally. Dorsal field of propodeum not outlined; its sculpture resembles that in *P. amenkei* sp. n. but much finer. Abdominal tergite VI bears sharp median carina. Body pubescence light-colored, mainly with golden tint. Coloration same as in male (Menke, 1968). Body length, 9.6 mm.

**Differential diagnosis.** *P. xanthosoma* resembles *P. amenkei* sp. n. in upper margin of metapleura not dilated; median lobe of clypeus protruding, trapeziform; supraclypeal sclerite short; median carina on lower part of frons divided dorsally; postscutellum yellow. *P. xanthosoma* differs from *P. amenkei* sp. n. in having dorsal branches of median carina of frons long; lateral ocelli almost touching inner eye orbits; fore coxae convex ventrally; dorsal field of propodeum with denser and finer sculpture; light coloration of clypeus, mesothorax, and propodeum, much more pronounced; body pubescence golden.

*Key to Species of the Genus Pisonoxylon (males of P. roosevelti sp. n. and P. amenkei sp. n. unknown)*

1. Metapleura dorsally with dilated lamellar margin. Median lobe of clypeus nearly straight in frontal view, with short rectangular protrusion; supraclypeal sclerite somewhat longer than wide. Lower part of frons with short, entire median carina. Dorsal part of propodeum with fine punctation and short transverse striae along median groove. Entire mesothorax and propodeum black. Bolivia ..... *roosevelti* sp. n.
- Metapleura dorsally without dilated protrusion. Median lobe of clypeus curved, trapeziform, protruding, with rim bent forward. Supraclypeal sclerite shorter than wide. Lower part of frons with long median carina, divided dorsally. Dorsal part of propodeum with dense oblique striae along median groove. At least postscutellum yellow ..... 2
2. Undivided part of median carina on lower part of frons considerably shorter than branches of this carina. Lateral ocelli almost touch inner eye orbits. Fore coxae convex anteriorly. Dorsal part of propodeum with noticeably denser and finer striae. Supraclypeal sclerite and clypeus entirely yellow white; mesothorax (except for dark spots on mesonotum and posterior  $\frac{1}{3}$  of scutellum) and propodeum (except for dorsal part) yellow; pubescence golden. Brazil, Peru ..... *xanthosoma* Menke, 1968

—Undivided part of median carina on lower part of frons no shorter than short branches of this carina. Lateral ocelli separated from inner eye orbits by no more than  $\frac{1}{3}$  ocellus diameter. Fore coxae flatly depressed anteriorly. Dorsal part of propodeum with coarser striae. Entire supraclypeal sclerite and clypeus (except for pale apical rim) brown; postscutellum yellow; other parts of mesothorax and entire propodeum dark brown; pubescence silvery, partly brown. Brazil ..... *amenkei* sp. n.

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