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Syntopic and synchronic occurrence of closely related species of the genus *Scarites* Fabricius in Amazonian Brazil

(Insecta, Coleoptera, Carabidae, Scaritinae)

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A sample of *Scarites* from Amazonian Brazil is examined. Altogether seven species have been sampled, including five taxa of closely related species of the subgenus *Scarites* s. str. Four species of the latter subgenus and additional two species of the subgenus *Lophogenius* Motschulsky were collected during an ecological survey carried out in *Várzea* areas in the vicinity of Manaus (see Adis et al. 1990), where they occur at the same locality. Apart from *Scarites* (s. str.) *cayennensis* Dejean, *S.* (s. str.) *illustris* Chaudoir, *S. (Lophogenius) trivialis* Chaudoir, and *S. (Lophogenius) smithi* Linell, three new species were collected that are described herein: *Scarites* (s. str.) *angustesulcatus*, *S.* (s. str.) *nitidiceps*, and *S.* (s. str.) *strigifrons*. All three taxa are very closely related to *S. cayennensis* Dejean. A key to the species of the *cayennensis-illustris*-group of species is provided.

The problems raised by the evolution and ecological balance of syntopic and apparently even synchronic occurrence of four species of extremely close relationships and similar size and structure are discussed. In spite of slightly different size and shape of the mandibles in the four species, no evidence is available so far that different feeding strategies could be responsible for the balance of their syntopic occurrence.

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Introduction

By courtesy of Prof. Dr. J. Adis (Plön) I received samples of *Scarites* s. str. specimens that were mainly collected during a large scale ecological survey carried out by MPIL, Plön in cooperation with INPA, Manaus (Adis et al. 1990), in *Várzea* areas in the vicinity of Manaus, central Amazonia, Brazil. Few specimens also were collected in the Roraima Territory at Rio Branco about 500 km north of Manaus, and at certain localities at Rio Solimões, between about 300 km and 500 km west of Manaus. Specimens were captured mainly using pitfall traps, few also at light.

The very large genus *Scarites* Fabricius includes about 250 taxa about half of which belong to the subgenus *Scarites* s. str. (Lorenz 1998). However, authors disagree about the subdivision of the genus in subgenera, and also about the taxonomic status of the subgenera. Because all taxa that are newly described in this paper belong to *Scarites* s. str., no difference which subgeneric concept is chosen, this question will be set aside for the considerations made in the present paper.

According to Bänninger (1938), the subgenus *Scarites* s. str. is characterized by elongate body shape with fully developed posterior wings, elongate metasternum and metepisternum, absence of transverse sulci on the abdominal sternites, presence of the clypeal seta, very commonly also by presence of a large second spine on the external surface of the median tibia, and generally by large size. The many species of this subgenus are distributed through all continents except Australia.

In South America the subgenus includes 14 taxa according to Bänninger (1938) and Lorenz (1998). Even today, Bänninger's key (1938, pp. 116-138) is the most recent key to the species, and it is still the base of all work done on the genus *Scarites* and its allies. All taxa mentioned in the present paper belong to the *cayennensis-illustris*-group of species that is characterized by presence of a discal seta in the anterior half of the elytra and by presence of setae at base of metasternum and apex of mesosternum.

Of the subgenus *Lophogenius* Chaudoir just few specimens of two species were captured. This subgenus is restricted to the New World and it is characterized by distinct transverse abdominal sulci, elongate metasternum and metepisternum, and presence of a group of setose punctures near the base of abdominal sternum 2.

Material

Altogether 156 specimens were examined for this paper. 135 of these were captured in pitfall traps during an ecological survey in *Várzea* areas near Manaus (Ilha de Marchantaria, fig. 1). The others were collected, partly at light, near Manaus and at certain localities at Rio Branco and Rio Solimões within a radius of about 500 km around Manaus. A part of the specimens sampled at Ilha de Marchantaria apparently were dissected for their gut contents. Those species that were more seriously damaged were identified, but, in case they belong to one of the species being described as new in the present paper, they were not included in the type series.

The holotypes of the new species are stored in Instituto Nacional de Pequisas da Amazônia, Manaus (INPA), paratypes are shared with INPA, Coll. Adis in Max-Planck-Institut für Limnologie, Plön (MPIL) and working collection M. Baehr in Zoologische Staatssammlung, München (CBM).

Methods

For the taxonomic treatment standard methods are used. The male genitalia were removed from specimens soaked for a night in a jar under wet atmosphere, then cleaned for a short while in hot KOH.

For examination of the generally fine though taxonomically important microstructure of the surface a stereo microscope with up to 64× magnification was used, supported by a lamp of high intensity giving natural light that could be focussed. For exact definition of the microsculpture such light is preferable, because fibre-glass optics substantially change the impression of the surface structures.

Measurements

Measurements were taken using a stereo microscope with an ocular micrometer. Length has been measured from apex of mandibles to apex of elytra. Although such measurements are not always exact, because closed mandibles yield other measurements than open ones, this method was chosen to make measurements comparable with those of other authors, especially Bänninger (1938). Length of pronotum was measured along the line from the most advanced point of the apex to the most advanced point of the base, width of pronotum at widest part. For the ratio length of mandible/length of head the left (upper) mandible was chosen. Length of head was measured in a straight line from the articulation of the mandible to the apical angle of the pronotum, length of mandible was measured in a straight line from the basal articulation to the apex of the mandible. Ratios are somewhat variable in most taxa, but generally they offer rather good measures of relative shape.

Characters

In this group of taxa which are externally extremely similar and certainly are also closely related, genital characters yield rather little distinguishing features. The aedeagus is fairly similar in all species of which male genitalia are at hand, and only shape of parameres shows more striking differences. But, as a rule, parameres vary rather widely within species. Thus, special attention was paid to shape and surface structure of mandibles, microsculpture of surface of head and elytra, and shape of pronotum and elytra. Therefore, the key to the taxa of the *cayennensis-illustris*-group mainly takes advantage of such character states of external structure.

Fig. 1. Ilha de Marchantaria near Manaus. Photo: By courtesy Prof. J. Adis.

Taxonomic decisions

Four of the five mentioned taxa of *Scarites* s. str. are so closely related that, at the first glance, they could be likely regarded subspecies of a single species, e.g. *S. cayennensis* Dejean, the more as their male genitalia are extremely similar. Because three taxa of these have been sampled at the same locality and probably in the same traps, the mentioned taxonomic procedure is not possible in view of the biological species concept, and the taxa have been thus described as species rather than subspecies.

The third new taxon has been also given full species rank, because the differences in external morphology are not larger or smaller than they are in the taxa mentioned above. Certainly, morphological taxonomy in this group of species is likely to have reached its limits and should be supplemented with other methods. As far as we are not able to observe the gene flow or we do not know the actual genetic barriers between taxa, however, morphology must serve these duties, and for heuristic reasons, names should be given to populations showing even slight differences in external and genitalic morphology.

The species

Subgenus *Lophogenius* Motschulsky

This name is used for those American species that were formerly included in the subgenus *Distichus* Bonelli. *Distichus*, which is commonly even regarded a separate genus, is characterized by distinct ventral strigae (transverse sulci near the base of the abdominal sternites) and elongate metasternum and metepisterna. The subgenus *Lophogenius* differs from the Old World species that further on belong to *Distichus* s. str. by presence of a group of setiferous punctures near the base of abdominal sternum 2.

Scarites trivialis (Chaudoir)

Chaudoir, 1980: 51; Bänninger 1938: 85; Lorenz 1998: 126.

Note. A small, easily identified, quite common species.

Distribution. According to Bänninger (1938), the species is distributed from the Amazonian part of Peru to Rio Solimões, probably also in

Fig. 2. *Scarites angustesulcatus*, spec. nov. Habitus. length: 30.4 mm.

Mato Grosso, south to Paraguay and northern Argentinia. The southern populations probably belong to another subspecies (? var. in Bänninger).

Collecting circumstances. The single specimen was collected in a ring-shaped pitfall trap exposed in grass near the waterline.

Material examined. 1♂, Ilha de Marchantaria, 15 km w. Manaus, 21.9.1987, leg. H. Höfer (INPA).

Scarites smithi Linell

Linell, 1898: 254; Bänninger 1938: 84; Lorenz 1998: 126.

Note. A very characteristic, easily identified, large species (for subgenus) that is characterized by its remarkably smooth head and nonstriolate mandibular sulcus.

Distribution. According to Bänninger (1938) the species is known from the area between Cayenne and the lower reaches of the Amazonas. Near Manaus apparently the ranges of both mentioned *Lophogenius* species overlap, because they were found at the same locality.

Collecting circumstances. Both specimens were collected in ring-shaped pitfall traps exposed in grass near the waterline.

Material examined. 1♂, 1♀, Ilha de Marchantaria, 15 km w. Manaus, 21.9. and 3.11.1987, leg. H. Höfer (CBM, INPA).

Subgenus *Scarites* s. str.

All five species mentioned below belong to the *cayennensis-illustris*-group of species which is characterized by presence of a discal seta in the basal half of the elytra, and by two setae each near base of metasternum and near apex of mesosternum. The three species described below as new all are very closely related to *S. cayennensis* Dejean.

Scarites illustris Chaudoir
Fig. 3

Chaudoir, 1880: 91; Bänninger 1938: 126, 148; Lorenz 1998: 128.

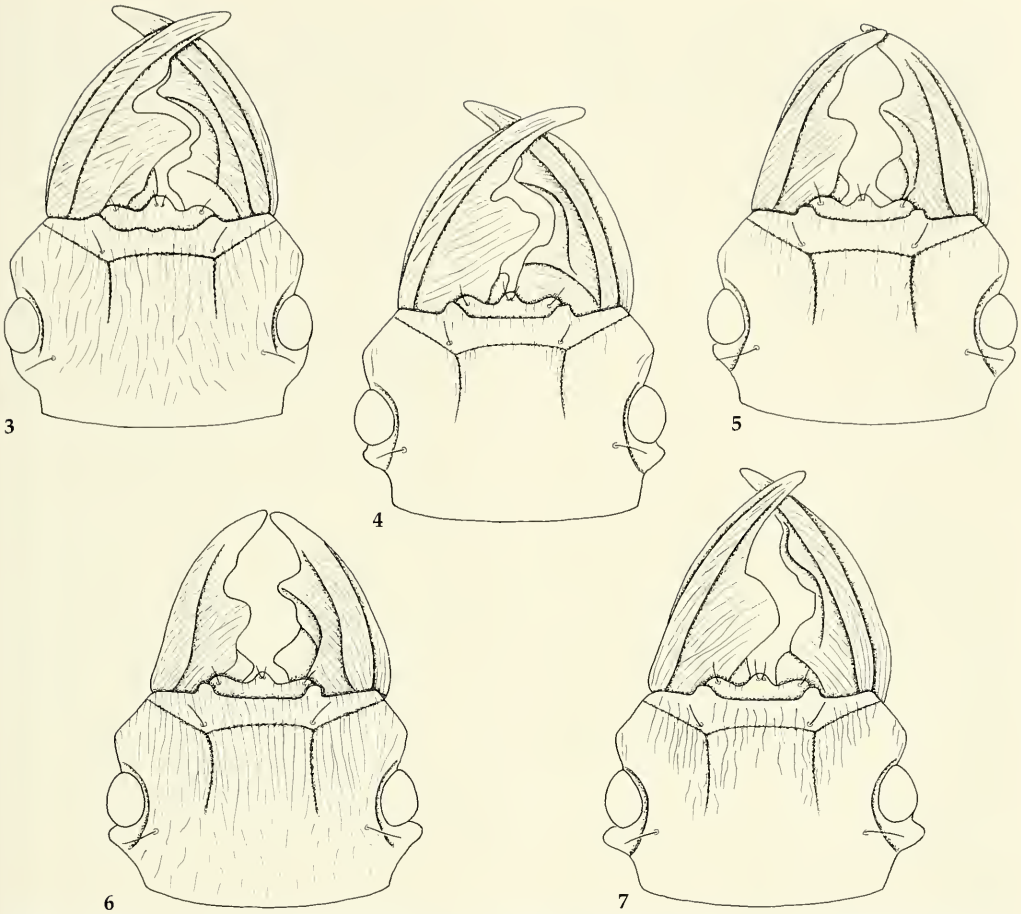
Note. The sampled specimens belong to the smaller, nominate subspecies (see key below).

Diagnosis. Slightly smaller and narrower species than those mentioned below, characterized *inter alia* by the densely striolate frons. Apart from its slightly lesser size, it is easily distinguished from *S. cayennensis* Dejean and the three species described below by longer, gently convex, laterally not at all protruding orbit (Fig. 3).

Distribution. According to Bänninger (1938, p. 148), the species is very widely distributed through almost the whole of South America. Because a subspecies *subcrenatus* Chaudoir was described and Bänninger noted some "variations", this species complex should be thoroughly studied.

Collecting circumstances. Most specimens were collected in ring-shaped pitfall traps exposed in grass near the waterline.

Material examined. 13 ex., Ilha de Marchantaria, 15 km w. Manaus, 14.9.-15.12.1987, leg. H. Höfer (CBM, INPA, MPIL), 1♀, Tefé, 11.3.1981, R. C. Best (MPIL).



Figs 3-7. Head. **3.** *Scarites illustris* Chaudoir. **4.** *S. cayennensis* Dejean (Coari). **5.** *S. nitidiceps*, spec. nov. **6.** *S. strigifrons*, spec. nov. **7.** *S. angustesulcatus*, spec. nov. Scales: 2.5 mm.

Scarites cayennensis Dejean
Figs 4, 8

Dejean, 1825: 384; Chaudoir 1980: 92; Bänninger 1938: 126, 148; Lorenz 1998: 128.

Diagnosis. Rather large species, distinguished from *S. illustris* Chaudoir by very short, protruding orbits and far less densely striolate frons. Distinguished from the three new species by more rounded lateral margins of pronotum; further on from both, *S. strigifrons*, and *S. angustesulcatus*, by absolute lack of granules on the elytral intervals and less densely striolate frons; and from *S. nitidiceps* by basally wider and more densely striolate mandibular sulcus.

Identification of this species was confirmed by comparison with specimens identified by Bänninger himself, because the type was not available.

For better distinction from related species, a revised description is given that mentions certain external and genitalic characters important for comparison.

Revised description

Measurements. Length: 32-35 mm. Ratios: Length of mandible/length of head: 1.10-1.15; width/length of pronotum: 1.34-1.40; length/width of elytra: 1.76-1.82.

Colour. Black, only antenna dark piceous. Basal angle of terminal visible abdominal sternum with small, light reddish patch.

Head (Fig. 4). Of average size. Anterior margin of clypeus bidentate, clypeus bisetose.

Margin of head in front of eyes laterally produced, anteriorly concave, not margined. Eye of average size, laterally slightly surpassing head. Orbit extremely short, remarkably convex, rather like a small ring, laterally not produced over eye, separated from eye by a rather deep sulcus. Supraorbital seta situated slightly in front of posterior margin of eye. Clypeal sutures distinct, frontal furrows rather deep, straight. Clypeus and frons near frontal furrows with some moderately distinct strioles, upper surface of head with few extremely fine strioles and very fine, scattered punctures, highly glossy. Labrum tridentate, with two lateral seta and two median setae originating from a common groove. Mandibles fairly elongate, with moderately wide mandibular sulcus that is slightly widened to base. Mola of left mandible large, apically rounded. Right mandible bidentate, with smooth area near base. Mandibular sulci densely striolate, strioles rather oblique. Molae of both mandibles densely and coarsely striolate. Mentum bisetose, lateral margin sharply bordered. Paragena anterioly excised, anterio-medially angulate, median margin not margined. Palpi and antenna of average size, median antennomeres slighty longer than wide.

Pronotum. Wide, apex rather deeply sinuate, anterior angles not produced. Lateral margins rather convex, distinctly narrowed to basal angles, also rather incurved to apical angles. Base laterally oblique, straight, median part of base relatively little produced. Basal angles distinct, dentiform. Apex not bordered, all other margins narrowly bordered. Anterior transverse sulcus distinct, complete, median line fine, complete. Surface depressed, impunctate, with few, extremely fine transverse strioles, highly glossy, only the very shallow basal impressions granulose. Both marginal setae present, anterior seta situated close to apex.

Elytra. Rather elongate, fairly parallel, dorsally rather depressed. Base and lateral margin densely granulose. Base with some elongate setae, near humerus rather gently margined, humerus with slight tooth. 3rd interval with a setiferous puncture at about basal third, and with 3, rarely unilaterally 2 or 4 punctures in apical half. Striae neither punctate nor crenulate, intervals gently convex, absolutely smooth, without any granules or punctures or transverse strioles, remarkably glossy.

Lower surface. Lower surface of head coarsely and rather densely punctate. Proepisternum with slightly granulose punctures, prosternum smooth, sternal process not setose. Mesepisternum and basal half of metasternum densely granulose, metepisternum more finely granulose, abdomen laterally densely striolate, highly coriaceous, in middle rather smooth and glossy. Mesosterum near apex, and metasternum near base with two setae each, abdominal sternum 2 with a group of setose punctures on either side. Metasternum considerably longer than metacoxa, metepisterum almost 3× as long as wide at apex. Sternum 6 in both sexes with 4 setae near apex, males with additional two setae on either side in middle near base.

Legs. Of average size. Protibia with 4-6 additional small teeth. Mesotibia with two large teeth of similar size.

Male genitalia (Fig. 8). Aedeagus short, compact, symmetric, with comparatively short, wide apex. Orificium symmetric, situated in middle on upper surface. Internal sac with two rather thickly sclerotized, symmetric sclerites that open to the orificium like the valves of a shell. Parameres large, of almost similar size and shape, rather regularly triangular, with straight upper margin and widely rounded apical angle, apical half of upper and lower margins densely setose.

Female stylomeres. Very similar to those of *S. strigifrons*, spec. nov. (see fig. 11).

Variation. The specimens from localities near Rio Solimões west of Manaus differ from typical *cayennensis* from Surinam by generally larger size, more convex lateral margins of prothorax at the average, and even shorter orbit. Nevertheless, they are included in *cayennensis*, because transitional specimens from the same locality seem to demonstrate that the mentioned differences might be simply allometric changes found in large specimens.

Distribution. According to Bänninger (1938) this species was so far recorded from Cayenne and from the Amazonian Basin east of Manaus. Now it is also known from several localities up to about 500 km west of Manaus.

Collecting circumstances. Except for a single specimen that was captured in ring-shaped pitfall traps in grass near waterline, collecting circumstances are unknown.

Material examined. 15 ex., Manaus, 14.2.1978, Altamira; Tefé, 11.3.1981, R. C. Best; Lago Amaná, 2.8. and 13.9.1979, Robin Best; Coari, 20.8.1979, R. Best; Rio Solimões, acíma de (above) Manacapurú, 18.8. 1979, R. Best; Ilha de Marchantaria, 15 km w. Manaus, 18.10.1987, leg. H. Höfer (CBM, INPA, MPIL).

Scarites nitidiceps, spec. nov.
Figs 5, 9

Types. Holotype: ♂, Brasil: Roraima, Caracarai, 13-V-1977, Norman D. Penny (INPA). – Paratypes: 2♂♂, same data (CBM, INPA); 1♂, 1♀, Brasil: Amazonas, Tefé, 11.3.1981, R. C. Best (CBM, MPIL).

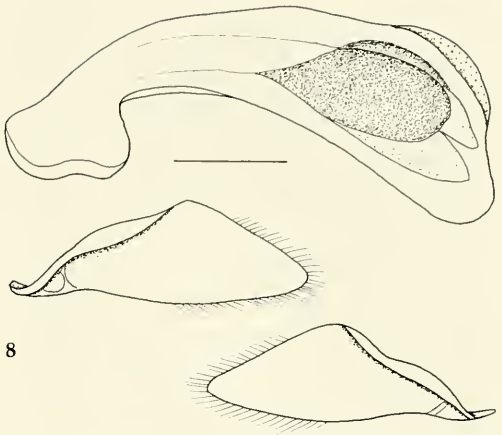
Diagnosis. Moderately large species, distinguished from *S. illustris*, *S. strigifrons*, and *S. angustesulcatus* by absolute lack of granules on the elytral intervals and almost non-striate frons, further from *S. illustris* Chaudoir by very short, markedly protruding orbits. Distinguished from most similar *S. cayennensis* by even less striolate frons and slightly longer mandibles with basally narrower and less densely striolate mandibular sulcus.

Description

Measurements. Length: 28-33 mm. Ratios: Length of mandible/length of head: 1.12-1.16; width/length of pronotum: 1.33-1.38; length/width of elytra: 1.82-1.90.

Colour. Black, only antenna dark piceous. Basal angle of terminal visible abdominal sternum with small, light reddish patch.

Head (Fig. 5). Of average size. Anterior margin of clypeus bidentate, clypeus bisetose. Margin of head in front of eyes laterally produced, anteriorly concave, not margined. Eye of average size, laterally slightly surpassing head. Orbit very short, remarkably convex, laterally not produced over eye, separated from eye by a rather deep sulcus. Supraorbital seta situated slightly in front of posterior margin of eye. Clypeal sutures distinct, frontal furrows, rather deep, straight. Clypeus and frons near frontal furrows with some very indistinct strioles, upper surface of head with extremely fine, very scattered punctures, highly glossy. Labrum tridentate, with two lateral seta and two median setae originating from a common groove. Mandibles elongate, with narrow mandibular sulcus that is even narrowed to base. Mola of left mandible large, angulate. Right mandible



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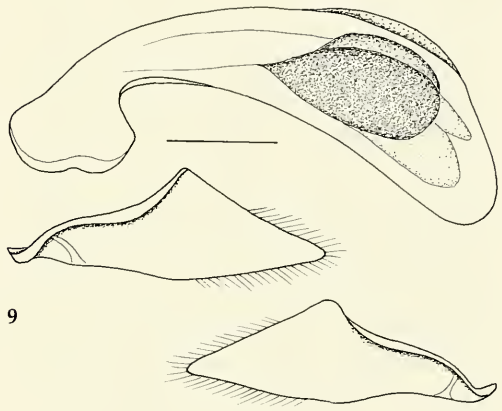

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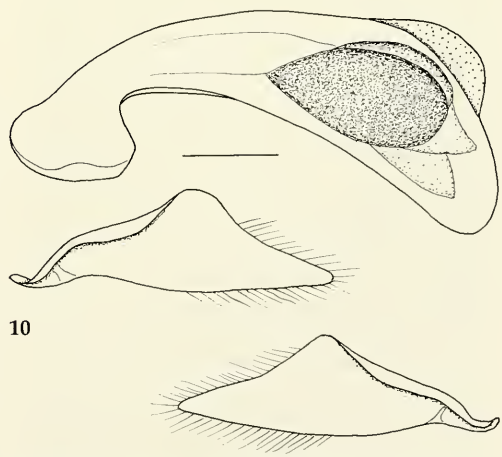

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Figs 8-10. Male genitalia: aedeagus and parameres. **8.** *Scarites cayennensis* Dejean (Coari). **9.** *S. nitidiceps*, spec. nov. **10.** *S. angustesulcatus*, spec. nov. Scales: 1 mm.

about bidentate, with smooth area near base. Mandibular sulci rather indistinctly striolate, strioles rather elongate. Molae of both mandibles fairly densely and coarsely striolate. Mentum bisetose, lateral margin sharply bordered. Paragena anterioly excised, anterio-medially angulate, median margin not margined. Palpi and antenna of average size, median antennomeres slighty longer than wide.

Pronotum. Wide, apex rather deeply sinuate, anterior angles not produced. Lateral margins little convex, little narrowed to basal angles. Base laterally oblique, straight, median part of base relatively little produced. Basal angles distinct, dentiform. Apex not bordered, all other margins narrowly bordered. Anterior transverse sulcus distinct, complete, median line fine, complete. Surface depressed, impunctate and without any transverse strioles, highly glossy, only the very shallow basal impressions granulose. Both marginal setae present, anterior seta situated very close to apex.

Elytra. Elongate, rather parallel, dorsally rather depressed. Base and lateral margin densely granulose. Base with some elongate setae, near humerus rather gently margined, humerus with slight tooth. 3rd interval with a setiferous puncture at about basal third, and with 3-4 punctures in apical half. Striae neither punctate nor crenulate, intervals gently convex, absolutely smooth, without any granules or punctures or transverse strioles, highly glossy.

Lower surface. Lower surface of head coarsely and rather densely punctate. Proepisternum with slightly granulose punctures, prosternum smooth, sternal process not setose. Mesepisternum and basal half of metasternum densely granulose, metepisternum more finely granulose, abdomen laterally densely striolate, highly coriaceous, in middle rather smooth and glossy. Mesosterum near apex, and metasternum near base with two setae each, abdominal sternum 2 with a group of setose punctures on either side. Metasternum considerably longer than metacoxa, metepisterum almost 3× as long as wide at apex. Sternum 6 in both sexes with 4 setae near apex and two setae in middle near base.

Legs. Of average size. Protibia with 3-5 additional small teeth. Mesotibia with two large teeth of similar size.

Male genitalia (Fig. 9). Aedeagus short, compact, symmetric, with comparatively elongate apex. Orificium symmetric, situated in middle on upper surface. Internal sac with two rather thickly sclerotized, symmetric sclerites that open to the orificium like the valves of a shell. Parameres large, of almost similar size and shape, regularly triangular, with straight upper margin and acute apical angle, apical half of upper and lower margins densely setose.

Female stylomeres. Very similar to those of *S. strigifrons*, spec. nov. (see fig. 11).

Variation. Due to the small number of specimens available, little can be said about variation. However, both specimens from Tefé at Rio Solimões are considerably larger than the three specimens from Rio Branco.

Distribution. So far recorded from Rio Branco about 500 km north of Manaus, and from Tefé at Rio Solimões, about 500 km west of Manaus.

Collecting circumstances. Unknown.

Etymology. The name is an adjective and refers to the remarkably smooth head.

Relationships. Certainly this species is most closely related to *S. cayennensis* Dejean.

Scarites strigifrons, spec. nov.
Figs 6, 11

Types. Holotype: ♀, MA (Ilha de Marchantaria, 15 km w. Manaus) BoF 17 20/10/81 (leg. Adis) (INPA). – Paratypes: same locality, all leg. Adis: 2♀♀, 1 (sex?), 20.1.1981; 1♀, 6.2.1981; 1♀, 16.3.1981; 1♀, 18.5.1981;1♀, 16.7.1981; 1♀, 1.X.1981; 5♀♀, 2 (sex?), 20.10.1981; 3♀♀, 2 (sex?), 4.11.1981; 3♀♀, 17.11.1981; 1♀, 3 (sex?), 2.12.1981; 1 (sex?), 21.12.1981; same locality, all leg. Höfer: 1♀, 14.9.1987; 1♀, 1 (sex?), 21.9.1987; 2♀♀, 1 (sex?), 15.10.1987; 1 (sex?), 3.11. 1987; 3♀♀, 3 (sex?), 17.11.1987; 1♀, 12.12.1987; 1♀, 13.12.1987; 1♀, 26.1.1987 (CBM, INPA, MPIL); 2♀♀, labels unreadable (INPA).

Diagnosis. Large species, distinguished from *S. illustris* Chaudoir by very short, markedly protruding orbits. Distinguished from both, *S. cayennensis* and *S. nitidiceps*, by presence of granules on the elytral intervals, and from *S. angustesulcatus* by more extended striolation on head and shorter mandibles with basally wider and more densely striolate mandibular sulcus, and by absence of a boss at inner rim of right mandible.

Description

Measurements. Length: 28-35 mm. Ratios: Length of mandible/length of head: 1.02-1.05; width/length of pronotum: 1.37-1.41; length/width of elytra: 1.78-1.85.

Colour. Black, only antenna dark piceous. Basal angle of terminal visible abdominal sternum with small, light reddish patch.

Head (Fig. 6). Of average size. Anterior margin of clypeus bidentate, clypeus bisetose. Margin of head in front of eyes laterally produced, anteriorly concave, not margined. Eye of average size, laterally slightly surpassing head. Orbit very short, remarkably convex, laterally distinctly produced over eye, separated from eye by a rather deep sulcus. Supraorbital seta situated slightly in front of posterior margin of eye. Clypeal sutures distinct, frontal furrows rather deep, straight. Almost the whole surface of head, including clypeus, very densely striolate, only at vertex strioles less dense and deep. Puncturation of surface barely visible. Surface moderately glossy, within the dense striolation fairly dull. Labrum tridentate, with two lateral seta and two median setae originating from a common groove. Mandibles moderately elongate, with fairly wide mandibular sulcus that is slightly widened to base. Mola of left mandible large, apically rounded. Right mandible about bidentate, with smooth area near base. Mandibular sulci densely striolate, strioles basally rather short. Molae of both mandibles fairly densely and coarsely striolate. Mentum bisetose, lateral margin sharply bordered. Paragena anterioly excised, anterio-medially angulate, median margin not margined. Palpi and antenna of average size, median antennomeres slighty longer than wide.

Pronotum. Wide, apex rather deeply sinuate, anterior angles not produced. Lateral margins little convex, slightly narrowed to basal angles. Base laterally oblique, almost straight to gently sinuate, median part of base relatively little produced. Basal angles distinct, dentiform. Apex not bordered, all other margins narrowly bordered. Anterior transverse sulcus distinct, complete, median line fine, complete. Surface depressed, posteriorly finely punctate, with several very fine transverse strioles, the very shallow basal impressions widely granulose. Both marginal setae present, anterior seta situated very close to apex.

Elytra. Elongate, rather parallel, dorsally rather depressed. Base and lateral margin densely granulose. Base with some elongate setae, near humerus rather thickly margined, humerus with distinct tooth. 3rd interval with one, or unilaterally even two setiferous puncture(s) at about basal fourth, and with 3-4 punctures in apical half. Striae neither punctate nor crenulate, intervals gently convex, with a row of more or less distinct granules on either side, and with many irregular transverse strioles, rather dull.

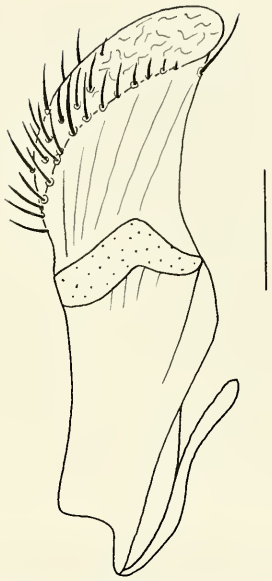

Fig. 11. *Scarites strigifrons*, spec. nov. Female stylomeres. Scale: 0.5 mm.

Lower surface. Lower surface of head coarsely and densely punctate. Proepisternum with slightly granulose punctures, prosternum smooth, sternal process not setose. Mesepisternum and basal half of metasternum densely granulose, metepisternum more finely granulose, abdomen densely striolate throughout, highly coriaceous, even in middle barely less coriaceous. Mesosterum near apex with two setae, metasternum near base with one or two setae on either side, abdominal sternum 2 with a group of setose punctures on either side. Metasternum considerably longer than metacoxa, metepisternum almost 3 x as long as wide at apex. Sternum 6 in both sexes with 4 setae near apex, apparently without additional setae in middle (males not definitely known).

Legs. Of average size. Protibia with 5-8 ad-

ditional small teeth. Mesotibia with two large teeth of similar size.

Male genitalia. Unknown.

Female stylomeres (Fig. 11). Very compact. Stylomere 1 without any setae at apex. Stylomere 2 short, with wide, depressed, oblique apex, and with multisulcate ventral surface. On median surface near apex with a single nematiform seta originating from a groove. Apex on ventro-lateral and dorso-lateral rim with several short and stiff setae originating from remarkably large pits. Also surface of apex with some setae of similar shape. Surface rugose.

Variation. Rather little variation noted apart from considerable differences of size which, however, do not seem to be caused by sexual variation.

Distribution. Ilha de Marchantaria in the immediate vicinity of Manaus, Amazonas, Brazil. Known only from type locality.

Collecting circumstances. All labelled specimens were collected in ring-shaped pitfall and Barber traps exposed in grass near the waterline.

Etymology. The name is an adjective and refers to the remarkably dense striolation of the head.

Additional material: Ilha de Marchantaria, 15 km w. Manaus, leg. Adis (INPA): 1 (sex?), 1.10.1981; 1♀, 13.10.1081; 1 (sex?), 20.10.1081; 1♀, 4.11.1981; 1♀, 17.11.1981.

Relationships. The species belongs in the *cayennensis*-assemblage and probably is next related to *S. angustesulcatus*, spec. nov.

Scarites angustesulcatus, spec. nov.
Figs 2, 7, 10

Types. Holotype: ♂, MA (Ilha de Marchantaria, 15 km w. Manaus) R Bol I/2, 17.11.87, (leg. Höfer) (INPA). – Paratypes: 4♀♀, 2 (sex?), same data; same locality, all leg. Höfer: 1 (sex?), 14.9.1987; 1 (sex?), 21.9.1987; 1 (sex?), 15.10.1987; 1♀, 16.10.1987; 1♀, 18.10.1987; 1♂, 19.10.1987; 1♂, 20.10.1987; 1♂, 2♀♀, 1 (sex?), 3.11.1987; 1♀, 19.1.1988; 1♀, 9.2.1988; same locality, all leg. Adis: 1♂, 17.2.1981; 1♀, 16.6.1981; 2♂♂, 1.10.1981; 14♂♂, 5 (sex?), 20.10.1981; 1♂, 22.10. 1981; 10♂♂, 1♀, 1 (sex?), 4.11.1981; 2♂♂, 17.11.1981; 3♂♂, 1♀, 2.12.1981; 2 (sex?), 21.12.1981 (CBM, INPA, MPIL); 1♀, Brasilien, Manaus,12.1982, leg. Schmidt (CBM).

Diagnosis. Large species, distinguished from *S. illustris* Chaudoir by very short, markedly protruding orbits. Distinguished from both, *S. cayennensis* and *S. nitidiceps*, by presence of granules on the elytral intervals and by more extended striolation of frons, and from *S. strigifrons* by less extended striolation on head, and longer mandibles with basally narrower and less densely striolate mandibular sulcus, and by presence of a boss at inner rim of right mandible.

Description

Measurements. Length: 30-36 mm. Ratios: Length of mandible/length of head: 1.10-1.15; width/length of pronotum: 1.38-1.46; length/width of elytra: 1.82-1.90.

Colour. Black, only antenna dark piceous. Basal angle of terminal visible abdominal sternum with small, light reddish patch.

Head (Fig. 7). Of average size. Anterior margin of clypeus bidentate, clypeus bisetose. Margin of head in front of eyes laterally produced, anteriorly concave, largely unmargined. Eye of average size, laterally slightly surpassing head. Orbit very short, remarkably convex, laterally distinctly produced over eye, separated from eye by a rather deep sulcus. Supraorbital seta situated slightly in front of posterior margin of eye. Clypeal sutures distinct, frontal furrows rather deep, straight. Anterior part of head, including clypeus, rather densely striolate, striolation not attaining the line between the posterior margins of eyes. Puncturation of surface anteriorly barely visible, on vertex fine and rather sparse. Surface moderately glossy, within the dense striolation fairly dull. Labrum tridentate, with two lateral seta and two median setae originating from a common groove. Mandibles elongate, with fairly narrow mandibular sulcus that is even slightly narrowed to base in some specimens. Mola of left mandible large, apically rounded. Right mandible about bidentate, with smooth area near base. Ridge above inner margin of mandible anteriorly developed into a produced boss. Mandibular sulci rather sparsely striolate, strioles rather elongate. Molae of both mandibles fairly densely and coarsely striolate. Mentum bisetose, lateral margin sharply bordered. Paragena anterioly excised, anterio-medially angulate, median margin not margined. Palpi and antenna of average size, median antennomeres slighty longer than wide.

Pronotum. Wide, apex rather deeply sinuate, anterior angles not produced. Lateral margins little convex, slightly narrowed to basal angles. Base laterally oblique, almost straight to gently sinuate, median part of base relatively little produced. Basal angles distinct, dentiform. Apex not bordered, all other margins narrowly bordered. Anterior transverse sulcus distinct, complete, median line fine, complete. Surface depressed, posteriorly finely punctate, with several very fine transverse strioles, the very shallow basal impressions widely granulose. Both marginal setae present, anterior seta situated very close to apex.

Elytra. Elongate, rather parallel, dorsally rather depressed. Base and lateral margin densely granulose. Base with some elongate setae, near humerus rather thickly margined, humerus with distinct tooth. 3rd interval with a setiferous puncture at about basal fourth, and with 3, rarely unilaterally 4 punctures in apical half. Striae neither punctate nor crenulate, intervals gently convex, with a row of always distinct granules on either side, and with many irregular transverse strioles, rather dull.

Lower surface. Lower surface of head coarsely and densely punctate. Proepisternum with slightly granulose punctures, prosternum smooth, sternal process not setose. Mesepisternum and basal half of metasternum densely granulose, metepisternum more finely granulose, abdomen densely striolate throughout, highly coriaceous, even in middle barely less coriaceous. Mesosterum near apex with two setae, metasternum near base with one or two setae on either side, abdominal sternum 2 with a group of setose punctures on either side. Metasternum considerably longer than metacoxa, metepisternum almost 3× as long as wide at apex. Sternum 6 in both sexes with 4 setae near apex and 2 setae in middle near base, in some specimens unilaterally without or with 2 setae.

Legs. Of average size. Protibia with 4-6 additional small teeth. Mesotibia with two large teeth of similar size.

Male genitalia (Fig. 10). Aedeagus short, compact, symmetric, with comparatively short apex. Orificium symmetric, situated in middle on upper surface. Internal sac with two rather thickly sclerotized, symmetric sclerites that open to the orificium like the valves of a shell. Parameres large, of almost similar size and shape, irregularly triangular, with markedly sinuate upper margin, apical half of upper and lower margins densely setose.

Female stylomeres. Very similar to those of *S. strigifrons*, spec. nov. (see fig. 11).

Variation. Little variation noted, apart from some variation of size.

Distribution. Immediate vicinity of Manaus, known so far only from Isla de Marchantaria.

Collecting circumstances. Almost all specimens were captured in ring-shaped pitfall and Barber traps, exposed in grass near waterline.

Etymology. The name is an adjective and refers to the narrow mandibular sulcus.

Additional material: Ilha de Marchantaria, 15 km w. Manaus, leg.Adis (INPA): 2 (sex?); 4.11.1981; 1♂, 2.12.1981.

Relationships. The species belongs in the *cayennensis*-assemblage and probably is next related to *S. strigifrons*, spec. nov.

Key to the species of the *cayennensis-illustris*-group of species of the subgenus *Scarites* s. str.

This key applies to the South American species of the subgenus *Scarites* s. str. that possess, at the same time: 1. a discal seta in the anterior half of the elytra and additional 3-4 setae in the posterior half; 2. a group of setae near base of metasternum and another near apex of mesosternum. This key replaces the captions 42-43 in Bänninger's key to the species of subgenus *Scarites* s. str. (Bänninger 1938, p. 126).

1. Orbit gently convex, distinctly narrower than eye, by far more than half as long as eye (Fig. 3) ..... 2.
– Orbit very convex, as wide as or wider than eye, short, but half as long as eye, or less (Figs 4-7) ..... 3.

2. Smaller, length 22-32 mm, elytra duller .... *illustris illustris* Chaudoir
– Larger, length >32 mm, elytra glossier .... *illustris subcrenatus* Chaudoir

3. Intervals without traces of granules, elytra remarkably glossy; striation on frons sparse and weak; orbit laterally not surpassing eye (Figs 4, 5) ..... 4.

– Intervals with more or less distinct granules, elytra duller; striation on frons dense and distinct; orbit laterally distinctly surpassing eye (Figs 6, 7) ..... 5.

4. Striation on frons still visible; mandibular sulcus wider, slightly widened towards base or of equal width, densely striolate (Fig. 4); pronotum with rather convex margins; both parameres with widely rounded apex (Fig. 8) ..... *cayennensis* Dejean

– Striation on frons barely visible; mandibular sulcus narrow, even narrowed towards base, indistinctly striolate (Fig. 5); pronotum with rather straight margins; both parameres with acute apex (Fig. 9) .... *nitidiceps*, spec. nov.

5. Striation on frons extremely dense, usually extended to behind eyes; mandibles shorter and stouter, right mandible without a convex boss on medio-dorsal border of apical half; mandibular sulcus widened towards base, densely striolate (Fig. 6); male genitalia unknown ..... *strigifrons*, spec. nov.

– Striation on frons less dense, usually ending in front of posterior margin of eyes; mandibles longer and narrower, right mandible with a convex boss on medio-dorsal border of apical half, mandibular sulcus narrow, even narrowed towards base, less densely striolate (Fig. 7); both parameres with markedly sinuate upper margin (Fig. 10) ..... *angustesulcatus*, spec. nov.

Remarks

The large sample of *Scarites* mentioned in this paper is very interesting from an ecological as well as from an evolutionary point of view, because four closely related and very similar taxa were collected at the same locality. Certainly, different species of the genus *Scarites* do occur together at the same place elsewhere, but usually the species belong to different subgenera, or, at least, they differ considerably in size or proportions. At the examined locality, however, four taxa occur that not only belong to the same subgenus, but also to the same species-group within the subgenus, and moreover, that barely differ in size and proportions, and not at all in shape and structure of their male genitalia.

This common occurrence strongly suggests sympatric speciation of the four species, although much too less is yet known about the real distribution of the species to dare any decision about the mode of their evolution, and virtually nothing is known about any probable genetic divergence. Hence, the problem of the evolution of the four species has been set aside in the present paper and only the etho-ecological implications are shortly discussed.

The question arises, then, how four taxa bearing extremely similar external structure manage to coexist at the same place. Certainly, the populations there must compete in some ways, not only for food, but also for space. As commonly two or three taxa have been found at the same date in the same traps, certainly there are no major seasonal differences of activity periods. This would be already unlikely, because the locality is inundated during the period from March to August (Adis et al. 1990) and thus, the burrowing species of the genus *Scarites* have a rather short period of activity on the ground. Admittedly, the species may have different diurnal activity periods which, however, was not examined in the survey. But even so, such differences seem rather improbable, since species of *Scarites* usually are active only at night.

Nevertheless, some seasonal differences in the activity between species yet may exist. In spite of the quite large numbers of specimens caught of both of the sympatric species, *S. strigifrons* and *S. angustesulcatus*, it is surprising why no males of *S. strigifrons* have been found, whereas in *S. angustesulcatus* the sex ratio is about at level. It is well known for a long time that in numerous carabid species of temperate areas in the northern hemisphere males and females possess somewhat different seasonal activity periods, although this subject was barely considered for species living in tropical regions. However, the striking differences in the mentioned *Scarites* species may be evidence either of a different seasonal activity, at least, of the males of one species *(S. strigifrons)*, or of different habits of the males during the period of sampling, in a way that they escaped from being captured in the pitfall traps. It should be mentioned, in this context, that all four species, in spite of being fully winged, have not been observed flying which they probably are able to do.

Another, though rather improbable, explanation of the total absence of males in the traps would be the hypothesis that *S. strigifrons* has a parthenogenetic way of reproduction. This exceptional reproduction mode has been noted sporadically in different beetle groups, though from my knowledge not yet in scaritines. To verify this hypothesis, examination of the full reproduction cycle under permanent observation would be needed.

However, even the apparent absence of males does not explain in which way competition of species should be prevented or, at least, reduced, because females of all species coexist. One conceivable means for the reduction of competition might be the slightly different body size: the smaller and narrower *S. illustris* compared with the three generally slightly larger species *S. cayennensis*, *S. strigiceps* and *S. angustesulcatus*. Though this hypothesis is not really convincing, because size generally varies to a quite large degree in *Scarites* species and also within the four species mentioned (see measurements above).

Another means for reducing competition may be the slightly different shape and length of the mandibles that could be evidence of slightly different feeding strategies or food preferences. However, species of *Scarites* whose feeding habits are better known, seem to be largely unspecialized feeders that seize all animals that they are able to subdue, including their own kind.

Hence, it remains rather puzzling, why and in which way so many extremely similar species have evolved and are able to survive in the same area, and moreover, in rather large numbers. For settling of this question, very scrutinized observations of the diurnal and seasonal cycle, the habits, and, in particular, of diet and foraging strategies of the syntopic species are requested.

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