

DESCRIPTION OF THE ADULTS AND PUPA OF *SIMULIUM (TRICHODAGMIA) PERPLEXUM*, NEW SPECIES (DIPTERA: SIMULIIDAE)

A. J. SHELLEY, M. MAIA-HERZOG\*, A. P. A. LUNA DIAS\* & C. A. COUCH

Medical Diptera Section, Department of Entomology, British Museum (Natural History), Cromwell Road, London SW7 5DB UK (WHO Collaborating Centre for the Study of Simuliidae and Phlebotominae in relation to Onchocerciasis and Leishmaniasis) \* Instituto Oswaldo Cruz, Departamento de Entomologia, Caixa Postal 926, 20001 Rio de Janeiro, RJ, Brasil

*Simulium perplexum*, new species, is described from the male, female and pupa and compared with the closely related *S. guianense* Wise. The distribution and biology of the new species are discussed. The confusion between *S. perplexum* and *S. guianense* has hitherto prevented accurate identification of the primary vector of human onchocerciasis in highland, hyperendemic areas of the Amazônia focus of Brazil and southern Venezuela.

Key words: Simuliidae – vector species of onchocerciasis – *Simulium guianense* – *Simulium perplexum* – Amazônia

As part of a detailed biosystematic study of the Simuliidae of the Brazilian Amazônia onchocerciasis focus, the identity of the principal anthropophilic species in the highland hyperendemic part of the focus was confirmed as *Simulium guianense* Wise (for background to the problem see Shelley, 1988 & Shelley et al., 1987; for full description of *S. guianense* see Shelley et al., in press). During the study a new species, previously confused with *S. guianense*, was discovered in collections from Guyana deposited in the British Museum (Natural History) by Dr J. Smart. A full description of the female, male and pupa of this new species, *S. perplexum*, is given here.

DESCRIPTION

*Simulium (Grenierella) perplexum* n. sp.

*Simulium perplexum* n. sp. Holotype ♀, Guyana: Kaieteur Falls, Potaro river, 1.ix.1937 (O. W. Richards & J. Smart) [British Museum (Natural History)].

Financial support was provided by the British Museum (Natural History), London; the Instituto Oswaldo Cruz, Rio de Janeiro; the Conselho Nacional de Desenvolvimento Científico e Tecnológico, Brasília and United Nations Development Programme/World Bank/World Health Organization (Special Programme for Research and Training in Tropical Diseases).

Received January 13, 1989.

Accepted June 22, 1989.

*Female* – General body colour black. Body length [pinned specimens] 1.9-3.2 mm (n = 14), wing length 2.3-2.8 mm (n = 14), wing width 1.0-1.2 mm (n = 13).

Coloration and morphology as in *S. guianense* with the following exceptions:

Antennae longer and thinner (Figs 1, 2), cibarium with small tubercles in central trough (Figs 3, 4).

Basal sector of radius of wing no setae (Figs 5, 6), claw of hind leg with well developed basal tooth (Figs 7, 8), and scales absent on legs.

Abdominal sternites II-VII with 1 + 1 lateral dark bands (Fig. 9). Paraprocts with internal extension well developed and sclerotised, and not membranous as in *S. guianense*; anterior tail-like process absent (Figs 10-13). Genital fork with lateral arms less developed than in *S. guianense* (Figs 14, 15). Spermatheca oval and well sclerotised as in *S. guianense* with differences in form of internal sculpturing setae; width of membranous area of insertion of spermathecal duct about one third maximum width of spermatheca (Figs 16, 17).

*Male* – General body coloration as in *S. guianense*. Body length [pinned specimens] 1.8-2.2 mm (n = 4), wing length 2.1-2.6 mm (n = 8), wing width 1.0-1.3 mm (n = 6).

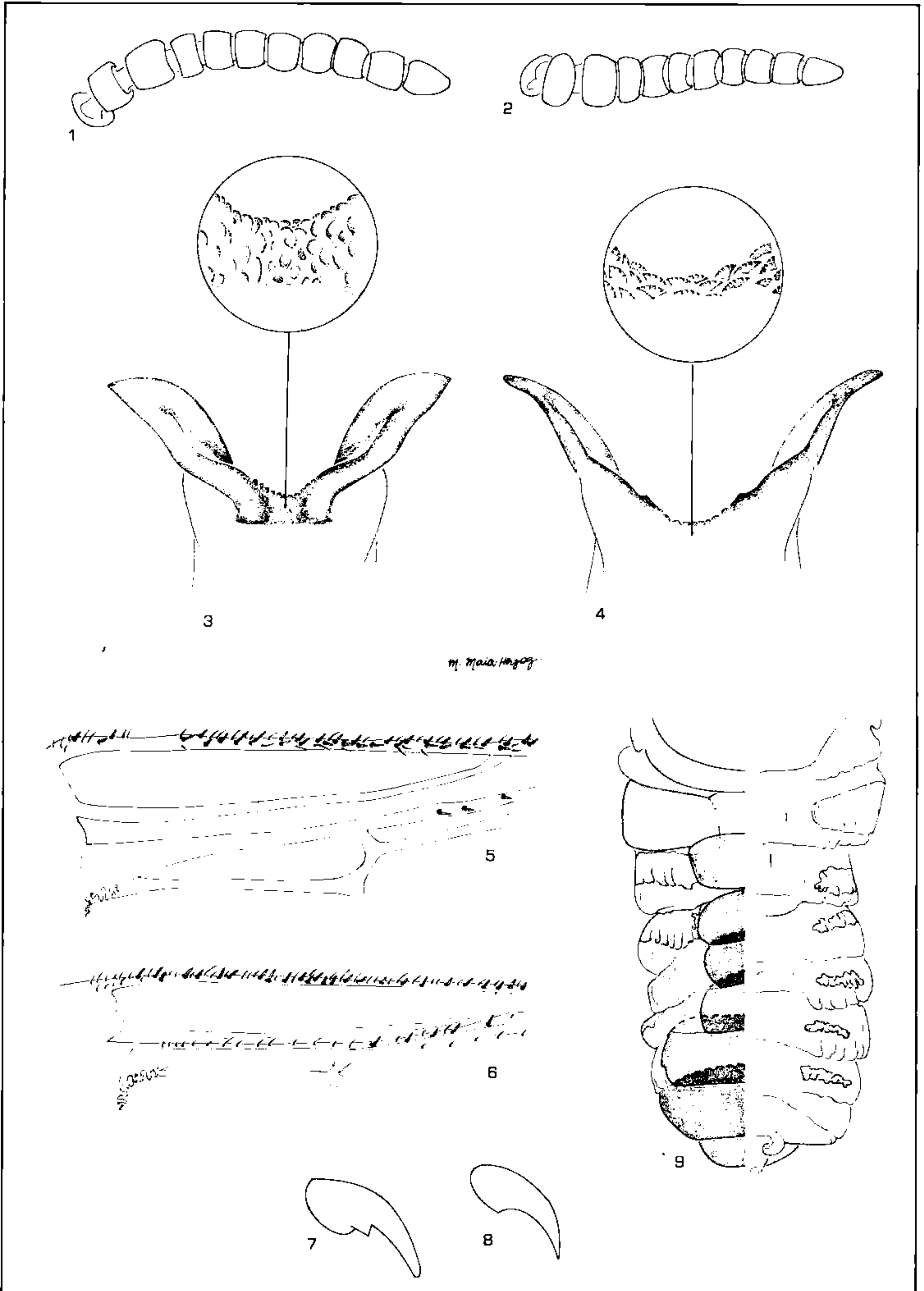


Fig. 1: antenna of female *Simulium perplexum*. Fig. 2: antenna of female *S. guianense*. Fig. 3: cibarium of female *S. perplexum*. Fig. 4: cibarium of female *S. guianense*. Fig. 5: anterior wing veins of female *S. perplexum*. Fig. 6: anterior wing veins of *S. guianense*. Fig. 7: claw of hind leg of female *S. perplexum*. Fig. 8: claw of hind leg of female *S. guianense*. Fig. 9: dorsal-ventral view of abdomen of female *S. perplexum*.

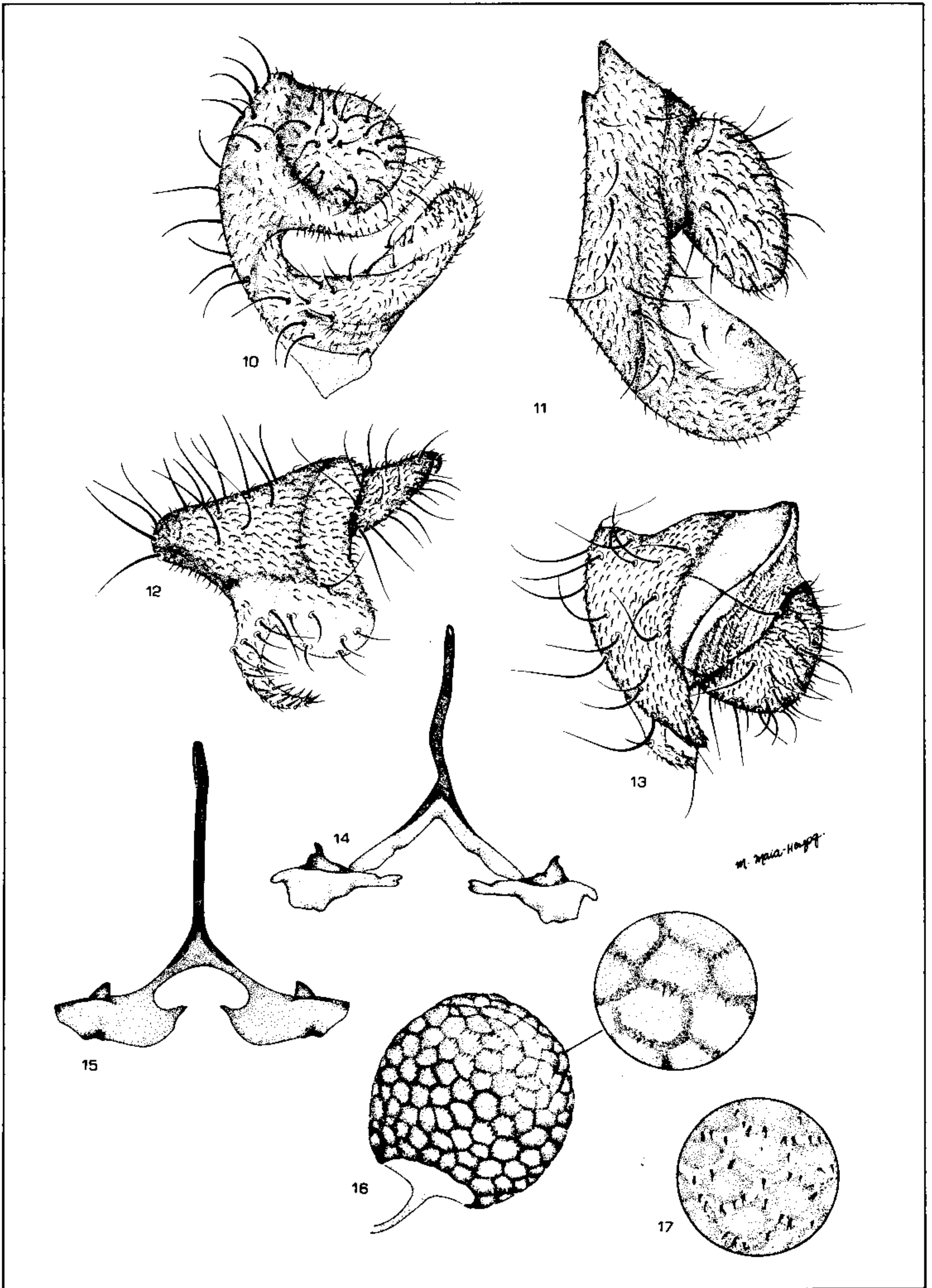


Fig. 10: ventral view of cercus and paraproct *S. perplexum*. Fig. 11: lateral view (external) of cercus and paraproct *S. perplexum*. Fig. 12: ventral view of cercus and paraproct *S. guianense*. Fig. 13: lateral view (external) of cercus and paraproct *S. guianense*. Fig. 14: genital fork *S. perplexum*. Fig. 15: genital fork *S. guianense*. Fig. 16: spermatheca *S. guianense* with details of setae and sculpturing. Fig. 17: details of setae and sculpturing of spermatheca *S. perplexum*.

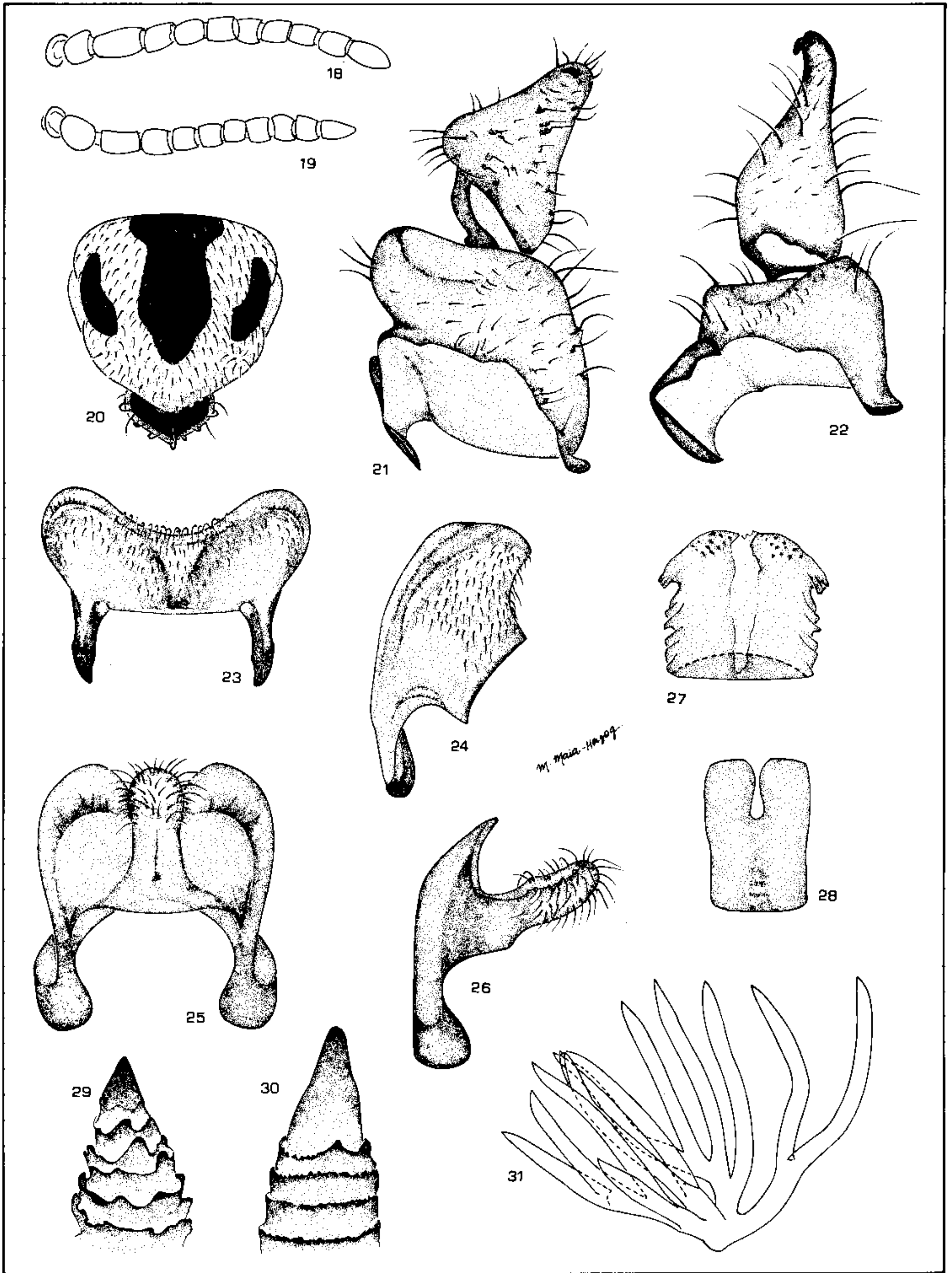


Fig. 18: antenna of male *S. perplexum*. Fig. 19: antenna of male *S. guianense*. Fig. 20: dorsal view of scutum of male *S. guianense*. Fig. 21: lateral (internal) view of gonocoxite and gonostyle *S. perplexum*. Fig. 22: lateral (internal) view of gonocoxite and gonostyle *S. guianense*. Fig. 23: ventral view of ventral plate *S. perplexum*. Fig. 24: profile of ventral plate *S. perplexum*. Fig. 25: ventral view of ventral plate *S. guianense*. Fig. 26: profile of ventral plate *S. guianense*. Fig. 27: median sclerite of *S. perplexum*. Fig. 28: median sclerite *S. guianense*. Fig. 29: distal portion of gill filament *S. perplexum*. Fig. 30: distal portion of gill filament *S. guianense*. Fig. 31: pupal gill *S. perplexum*.

Coloration and morphology as in *S. guianense* with the following exceptions:

Antennae wider and longer (Figs 18, 19); pedicel, scape and first two flagellomeres orange-brown.

Scutum, humeri and paranotal folds velvet black; darker median line extending from anterior scutal border for two thirds length of scutum with light source anterior to specimen. Scutum light grey with dark median line, as in female, with light source posterior to specimen. Scutum covered in groups of golden scale-like hairs with green reflections and long dark brown setae especially on anterior and posterior borders. The male is easily separated from that of *S. guianense* which has a silver and grey pattern to the scutum (Fig. 20).

Leg form and coloration as in *S. guianense* except scales on legs absent.

Genitalia different to *S. guianense* in that gonostyle broader at base and hence subtriangular in form, with smaller distal pointed spine instead of larger terminally rounded spine of *S. guianense*. Gonocoxite almost square compared with subrectangular gonocoxite of *S. guianense*, which is wider than long (Figs 21, 22). Ventral plate similar in basic shape to that of *S. guianense* except basal arms narrower and main body of plate shallower and without ventral protuberance (Figs 23-26). Median sclerite subrectangular, basal margin with fine spines and distal margin without apical incision (Figs 27, 28).

*Pupa* — As in *S. guianense* (Fig. 29) except annulations on more distal parts of gill filaments more accentuated with forwardly-directed processes rather than spicules (Figs 30, 31). Abdominal chaetotaxy was not observed due to the poor quality of material.

*Larva* — Unknown.

MATERIAL EXAMINED

*S. perplexum*

Holotype ♀, paratypes 16 ♀, 14 ♂, 1 pharate male pupa, 2 pupal skins, *Guyana*: Kaieteur Falls, Potaro river (5°09'N and 59°29'W), 1.ix.1937 (holotype), 1, 4, 9.ix.1937 (paratypes), (O. W. Richards & J. Smart) (BMNH);

1 ♀ paratype, Amatuk Falls, Potaro river, 31.viii.1937 (O. W. Richards & J. Smart) (BMNH); 3 ♀ paratypes, Warratuk Falls, Potaro river, 31.viii.1937 (O. W. Richards & J. Smart) (BMNH).

*S. guianense*

Lectotype ♀, *Guyana*: Lower Rupununi river, 1908 (Melville) (BMNH); 3 paralectotype ♀ (data as for lectotype). *S. pinto* d'Andretta & d'Andretta paratype ♀ (ex pupa) (no. 999), paratype ♂ (no. 1020), paratype pupal pelt (♂) (no. 1014), paratype pupal pelt (♀) (no. 987) of *S. pinto*, *Brazil*: São Paulo State, Piracicaba, 28.viii.1944 (Vulcano Andretta & Andretta Jr.) (BMNH). [Synonym of *S. guianense* Wise. See Shelley et al., in press].

*Brazil*: Roraima Territory: 42 ♀, Mission Post, R. Auaris (4°08'N and 64°29'W), 7.vii.1976, 29.iii-1.iv.1977 and 8.xii.1986 (R. R. Pinger, A. J. Shelley & A. P. A. Luna Dias) (BMNH); 2 ♂ (ex pupae) 1 pupa Caracará, Cachoeira Bem-Querer, Rio Branco, 16.i.1979 (A. J. Shelley & A. P. A. Luna Dias) (BMNH); 2 ♀ (ex pupae), 7 ♂ (ex pupae) 20 pupae, 10 larvae, Catrimani Mission Post, R. Catrimani, 9.i.1977 and 12.i.1979 (A. J. Shelley & A. P. A. Luna Dias) (BMNH); 3 ♂ (ex pupae), 4 ♂ (ex pupae), 1 pupa, 4 larvae, Boa Vista — BV8 Road, R. Urariquera 20.i.1979 (A. J. Shelley & A. P. A. Luna Dias) (BMNH); 1 ♀ Surucucus FUNAI Post, Dalem, 11.xii.1986 (A. J. Shelley & A. P. A. Luna Dias) (BMNH); 22 ♀ (ex pupae), 38 ♂ (ex pupae), numerous pupae and larvae, Mucajaí, Mission Post, R. Mucajaí and Coroconá, 5.i.1977, 22.vii.1984 (A. J. Shelley & A. J. Shelly & A. P. A. Luna Dias) (BMNH); 5 ♀ (ex pupae), 13 ♂ (ex pupae) Vila Pereira, R. Surumu, 25.xi.1980 (A. J. Shelley & A. P. A. Luna Dias) (BMNH); 1 pupa, 3 larvae, Boa Vista — BV8 Road, km 14 from Vila Pereira turnoff, R. Surumu, 11.viii.1984 (A. J. Shelley & A. P. A. Luna Dias) (BMNH); Amazonas State: 13 ♀ Mission Post, Rio Toototobi, 26.ii.1976, 24.x.1976, 12.xii.1976, 19.vii and 1.xii.1977 (A. J. Shelley & R. R. Pinger) (BMNH); Pará State: 6 ♀, near Altamira, km 100 Transamazon highway, Piranhaguara, R. Xingu, 7.ii.1984 (T. Harvey) (BMNH); 3 ♀ (ex pupae) 113 ♀, 2 ♂ (ex pupa), near Altamira, Laranjal, R. Iriri, vii.1984 (T. Harvey) (BMNH); 39 ♀, near Altamira, km 75 Transamazon highway, Oca Mineral Company, vii.1984 (T. Harvey) (BMNH);

45 ♀, 3 ♂, Uruá, R. Tapajós, 1.ix.1978 and 29.viii.1979 (L. A. Lacey) (BMNH); 1 ♀ near Itaituba, R. Uruá, 12.x.1977 (B. Ratcliffe) (BMNH); 17 ♀, Marabá-Altamira road, R. Anapu, 8.iv.1976 (W. Arouck) (BMNH).

*Guyana*: 37 ♀, Orinduik, R. Tumong, 2.xii.1970 (J. B. Davies) (BMNH).

*Surinam*: 2 ♀, Kabelebo river, km 113 camp, 21.ix.1980 (K. E. Neering) (BMNH); 3 ♀ Aseli Kamp, Gran Santi, Lawa river, 24.v. & 15.xi.1979 (J. E. Hudson) (BMNH); 6 ♀ Poeketi, Drierabberje & Saje on R. Tapanahony, 17 & 19.i.1979 & 9.v.1980 (J. E. Hudson) (BMNH); 2 ♀ Apoma Tapoe, Marowijne river, 19.xi.1979 (J. E. Hudson) (BMNH); 2 ♀ Kwamala Samoetoe, Sipaliwini river, 15 & 16.ii.1979 (J. E. Hudson) (BMNH).

*Venezuela*: 4 ♀, Amazonas Territory, Coyoweteri, R. Orinoquito, 24.vii.1986 (M. G. Basanez) (BMNH); 3 ♀, 3 ♀ (ex pupae) 3 ♂ (ex pupae), Bolivar State, Via Caicara, Salto Chaviripa, 28.x.1986 (V. Park) (BMNH).

#### TAXONOMIC DISCUSSION

The type series consists of pinned reared males and females from the Kaieteur, Amatuk and Warratuk Falls of the Potaro river, a man-biting female from the Kaieteur Savanna and two males attracted to light at the Kaieteur rest house as well as slide preparations made by Smart of pupae, males and females. Although most adults were reared from pupae only two pupal skins are in the BMNH collection and these are not associated with adults. The only link between adults and pupae occurs on a slide preparation by Smart, who had removed the abdomen from a male pharate pupa. This dissection has now been completed and the male on the slide found to be identical morphologically to preparations made from dissected pinned males. A pinned female from Kaieteur Falls reared by Smart but now lacking its pupal skin has been selected as holotype.

Smart (1940) used this material in his redescription of *S. guianense*, which had previously only been superficially described by Wise from the female (Anon., 1912; Wise, 1911). Smart considered his new material, collected in 1937 from the Potaro river (a tributary of the lower reaches of the Essequibo river), to be conspecific with the type series of

*S. guianense* collected by Wise from the Lower Rupununi river (a tributary of the upper reaches of the Essequibo river). Based on his own material Smart figured the pupa and male terminalia (from which he neglected to draw the terminal spines on the gonostyles) of "*S. guianense*". In a later paper (1942) Smart figured (incompletely) the cercus, paraproct and genital fork of "*S. guianense*".

We have now examined all the material in the BMNH collection that Smart identified as *S. guianense* and described and figured in his two papers (Smart, 1940; 1942), and compared this with the lectotype female and three paralectotype females of *S. guianense* described by Wise (Anon., 1912; Wise, 1911) and numerous reared specimens of male and female *S. guianense*. We conclude that all of Smart's material is of a single species of the subgenus *Grenierella* but not conspecific with *S. guianense*. This new species has been named *S. perplexum* (Latin *perplexus*, meaning puzzling) because of the considerable confusion that it has caused in the identification of *S. guianense* in the Amazônia onchocerciasis focus.

#### DISTRIBUTION

*S. perplexum* has been recorded only from eastern Central Guyana on the Potaro river, whereas the distribution of *S. guianense* is wider, occurring in southern Guyana, French Guyana, Surinam, Brazil and Venezuela.

#### BIOLOGY

*Simulium perplexum* (as *S. guianense*) was recorded as biting man by Smart (1940) and two of the males in the BMNH were collected at lights at Kaieteur rest house. Larvae and pupae are found on Podostemaceae that occur on rocks in rapids and waterfalls (Smart, 1940).

#### RESUMO

**Descrição dos adultos e da pupa de *Simulium (Grenierella) perplexum*, espécie nova (Diptera: Simuliidae)** — Macho, fêmea e pupa de *Simulium perplexum* sp. n. são comparados com sua espécie próxima *S. guianense* Wise. Discutimos sua biologia e distribuição. A identidade incerta de *S. guianense* impedia a correta identificação do vetor primário da onco-

cercose humana nas áreas elevadas e hiperendêmicas do foco amazônico brasileiro e venezuelano.

Palavras-chave: Simuliidae – espécie vetora de oncocercose – *Simulium guianense* – *Simulium perplexum* – Amazônia

#### ACKNOWLEDGEMENTS

To Dr J. Sandoval and his staff of SUCAM, Roraima for facilitating field collections.

#### REFERENCES

ANON., 1912. The "Itanimi fly". – A new *Simulium* in British Guiana. *J. Trop. Med. & Hyg.*, 15: 43. [This is a republication of the original description (minus drawing) of *S. guianense* by Wise (1911)

in his paper on the Simuliidae of British Guiana].  
SHELLEY, A. J., 1988. Vector aspects of the epidemiology of onchocerciasis in Latin America. *Ann. Rev. Entom.*, 30: 337-366.  
SHELLEY, A. J.; LUNA DIAS, A. P. A.; MAIA-HERZOG, M.; PROCUNIER, W. S. & MORAES, M. A. P., 1987. Identification of vector species (Diptera: Simuliidae) human onchocerciasis in the Amazônia focus of Brazil and Venezuela. *Mem. Inst. Oswaldo Cruz*, 82: 461-465.  
SHELLEY, A. J.; MAIA-HERZOG, M.; LUNA DIAS, A. P. A.; COUCH, C. A. & MORAES, M. A. P. (In press). Byosistemactic studies on the Simuliidae of the onchocerciasis focus in Brazil. *Bull. British Mus. (Nat. Hist.) Entomol. Ser.*  
SMART, J., 1940. Simuliidae (Dipt.) from British Guiana and the Lesser Antilles. *Trans. R. Entomol. Soc. London*, 90: 1-11.  
SMART, J., 1942. Notes on Simuliidae (Diptera). *Proc. R. Entomol. Soc. London (B)*, 11: 46-50.  
WISE, K. S., 1911. The Simuliidae of British Guiana. *Timehri*, 1: 248-254.