

## THE SIMULIIDAE (DIPTERA) FROM THE SOLOMON ISLANDS, SOUTH PACIFIC

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**Abstract:** Nine black fly species including five new species were taxonomically studied, chiefly on the basis of reared adults, pupae and mature larvae collected from the Solomon Islands, South Pacific. All species, but one in *Simulium* (*Gomphostilbia*), were placed in *Simulium* (*Morops*). Within the subgenus *Morops* four were further classified into the *clathrinum*-group, one into the *papuense*-group and three remained ungrouped. *S. (M.) papuense* was newly recorded from the Solomon Islands. Descriptions of all new species and redescription of *S. (M.) sherwoodi* were given; mature larvae of *S. (M.) sherwoodi* and *S. (M.) kerei* were described for the first time. The pupal pit-like organs of all five known species of the *clathrinum*-group from Papua New Guinea and Australia were also illustrated.

Black flies (Diptera: Simuliidae) of the Solomon Islands, South Pacific were little studied. Stone and Maffi (1971) described *Simulium* (*Morops*) *sherwoodi*, and recorded the other black fly species (as *S. (M.)* sp. nr *avilae*) from Guadalcanal Island. Recently we described two new species: *S. (Gomphostilbia) hiroshii* from New Georgia and Guadalcanal Islands, and *S. (M.) kerei* from New Georgia Island (Takaoka, 1994; Takaoka and Suzuki, 1994).

In this study nine species including five new and one newly recorded species were treated on the basis of reared adults, pupae and mature larvae collected from Guadalcanal and New Georgia Islands in 1992 and 1993 by one of us (HS).

Descriptions of five new species and redescription of *S. (M.) sherwoodi* are given, and mature larva of *S. (M.) sherwoodi* and *S. (M.) kerei* is described for the first time.

Type specimens will be deposited in the Natural History Museum (BMNH), London, U.K.

Genus *Simulium* Latreille s. l.

Subgenus *Gomphostilbia* Enderlein

The subgenus *Gomphostilbia* was well defined by Crosskey (1967) and recently revised by Takaoka and Davies (1995). This subgenus is characterized by the bare pleural membrane and haired katapisternum of adults of both sexes. From the Solomon Islands only one

species, *S. (G.) hiroshii*, was known (Takaoka, 1994). It is noteworthy that this species is very unique in having several characters which depart from the diagnosis of *Gomphostilbia* but agree with those of *Morops* or *Simulium* s. str., as mentioned by Takaoka (1994).

### 1. *Simulium* (*Gomphostilbia*) *hiroshii* Takaoka, 1994

*Simulium* (*Gomphostilbia*) *hiroshii* Takaoka, 1994: 97-101.

SPECIMENS EXAMINED. 1 pupa, 1 pupal exuvia and 22 mature larvae (all in alcohol), collected from a stream, Noro, New Georgia Island, Western Province, Solomon Islands, 21. II. 1993, by H. Suzuki; 1 pupa and 1 mature larva, collected from a stream, Selwyn College, Guadalcanal Island, Solomon Islands, 12. VIII. 1993, by H. Suzuki.

DISTRIBUTION. Solomon Islands (New Georgia Island and Guadalcanal Island).

REMARKS. This species was originally reported from the Solomon Islands (Takaoka, 1994). The pupa and larva were collected for the first time from the Guadalcanal Island where only the adult female and male had been previously known.

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### Subgenus *Morops* Enderlein

This subgenus was well defined by Crosskey (1967) and was divided into several species-groups (Crosskey, 1967; Colbo, 1976). The subgenus *Morops* is characterized by the haired pleural membrane and katepisternum of adults of both sexes. In this study, all the nine, but one in subgenus *Gomphostilbia* Enderlein, are assigned in this subgenus; four species are further classified into the *clathrinum*-group and one is into the *papuense*-group and three remain ungrouped.

#### (A) *clathrinum*-group

This species-group is easily distinguished by having the pit-like cuticular organ at the base of pupal gill filaments (Crosskey, 1967). To express relative size of the pit-like organ needed for species identification, *pit-like organ* ratio (=A/B), abbreviated as *plo* ratio, is here proposed, where A is a diameter of the pit-like organ and B is a distance from its innermost margin to the middle longitudinal suture of the thorax (see Fig. 12). The pit-like organs of all the five known species of the *clathrinum*-group are illustrated and measured for *plo* ratio.

Stone and Maffi (1971) recorded *S. (M.)* sp. nr *avilae* Smart & Clifford, on the basis of the pupal and larval specimens from Guadalcanal Island, which was the only species of the *clathrinum*-group from the Solomon Islands. This unidentified species may be *S. (M.) pohaense* sp. nov. or *S. (M.) selwynense* sp. nov., both of which are very similar to *S. (M.) avilae*, as noted later.

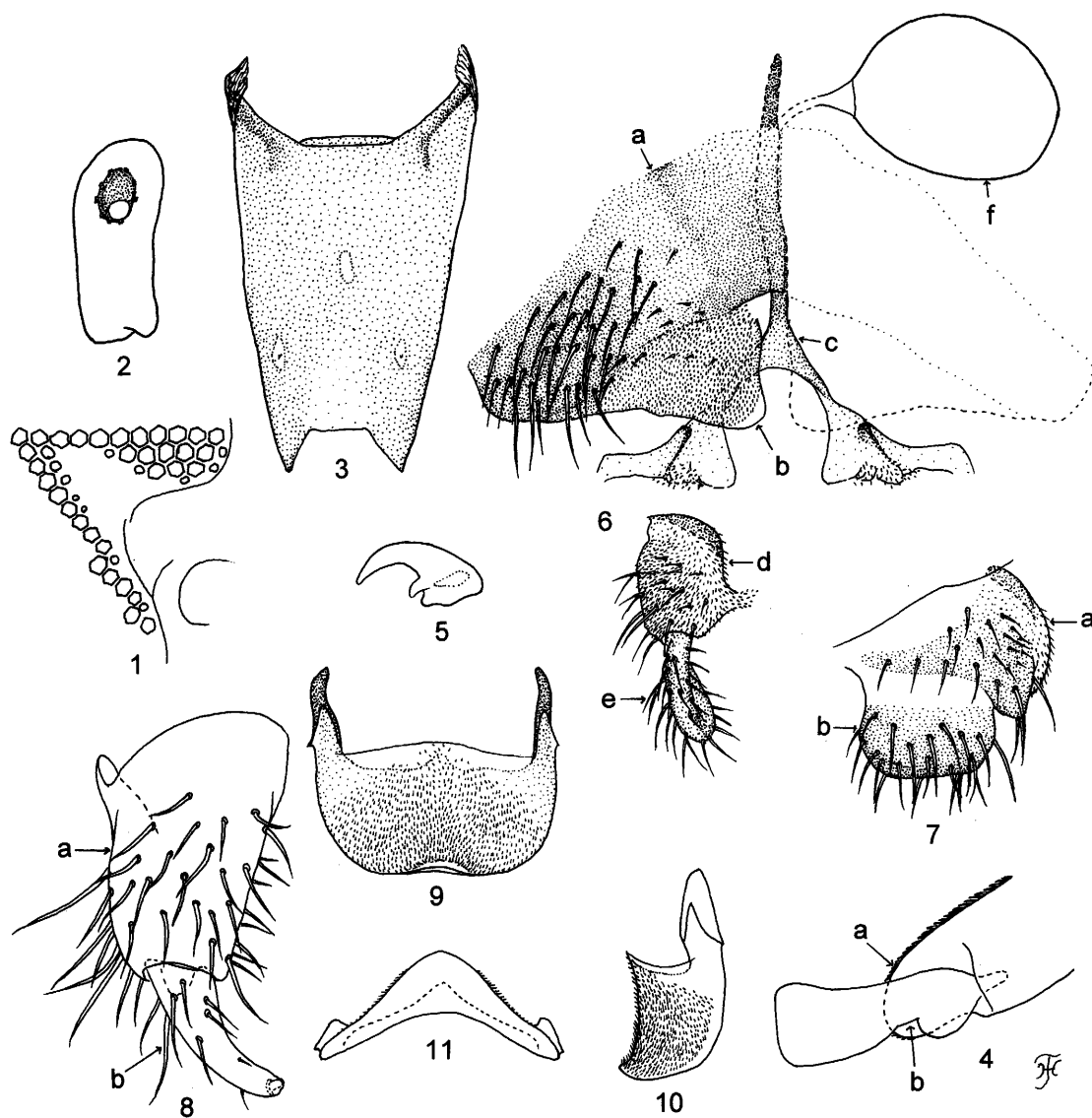
## 2. *Simulium (Morops) solomonense* sp. nov.

**DESCRIPTION. Female** (coloration incomplete). Body length ca. 2.5 mm. **Head.** Slightly narrower than thorax. Frons dark brown, densely covered with yellowish white, scale-like, recumbent pubescence, interspersed with several dark hairs along both lateral margins; frontal ratio 1.57:1.00:1.87. Frons-head ratio 1.00:4.75. Fronto-ocular area (Fig. 1) well developed. Clypeus dark brown, densely covered with yellowish white, scale-like, recumbent pubescence interspersed with several dark hairs. Antenna composed of 2+9 segments, pale. Maxillary palp with 5 segments; proportional lengths of 3rd, 4th and 5th segments 1.0:1.0:1.7; 3rd segment somewhat enlarged, sensory vesicle (Fig. 2) ellipsoidal, 1.6 × as long as wide, 0.3 × as long as 3rd segment, with a moderate opening near distal end. Maxillary lacinia with 7 or 8 inner and 10 outer teeth. Mandible with ca. 20 small inner teeth and 1 or 2 outer teeth near apex.

Cibarium (Fig. 3) with upper margin widely bent forwardly, lacking any processes. **Thorax.** Scutum dark brown in ground color, densely covered with yellowish white, recumbent pubescence except median, large area with dark brown pubescence; 3 longitudinal vittae of yellowish white, recumbent pubescence (1 median vitta narrow and 2 submedian ones rather wide), which are connected anteriorly and posteriorly to areas of the concolored pubescence; long, erect, dark hairs present on prescutellar area. Scutellum blackish brown with yellowish white pubescence and many long, erect, dark hairs. Postscutellum blackish brown, bare. Pleural membrane with ca. 120 yellowish white pubescence and a few dark hairs. Katepisternum longer than deep, dark brown, with numerous, yellowish white pubescence and dark hairs; sulcus distinct. **Legs.** Foreleg: coxa and trochanter pale yellow; femur pale yellow with apical cap brown; tibia pale yellow with basal and distal 1/4 brown; tarsus brown; basitarsus somewhat dilated, ca. 5.8 × as long as its greatest width. Midleg: coxa dark brown; trochanter pale yellow; femur pale yellow with apical cap brown; tibia brownish with median large portion pale; tarsus brown. Hind leg: coxa pale yellowish brown; trochanter pale yellow; femur pale yellow with apical cap brown; tibia brownish with base and median large portion pale yellow; tarsus pale brown with basal 3/5 of basitarsus and basal 1/2 of 2nd tarsomere white; basitarsus slender, parallel-sided, ca. 6.7 × as long as wide. Calcipala (Fig. 4a) well developed, as long as wide. Pedisulcus (Fig. 4b) well developed. Hind femur and tibia 2.1 × and 1.6 × as wide as hind basitarsus, respectively. All femora and tibiae densely covered with scale-like hairs on outer surface. Claws (Fig. 5) each with a small basal tooth. **Wing.** Length 1.7 mm. Costa with spinules as well as hairs. Subcosta haired. Hair tuft on stem vein dark brown. Basal portion of radius fully haired. **Abdomen.** Basal scale brown with fringe of yellowish white hairs. Dorsal surface of segments 2-5 very densely covered with scale-like, recumbent pubescence, which is yellowish white on segment 2 but brown dorsally and yellowish white laterally on segments 3-5; that of segments 6 and 7 moderately covered with yellowish white, recumbent pubescence and dark hairs; that of segments 8 and 9 moderately covered with yellowish white, short hairs and dark, longer hairs; tergite of 2nd segment whitish pruinose, tergites of segments 6-8 shiny. **Genitalia.** Sternal plate undeveloped on abdominal segment 7. Sternite 8 (Fig. 6a) bare medially, with 32-36 macrosetae on each side. Anterior gonapophysis (Fig. 6b) triangular, thin, membraneous, covered densely with microsetae

interspersed with a few setae; inner margin well sclerotized. Genital fork (Fig. 6c) of usual inverted-Y form, with arms rather broad, folded medially, without projection directed forward; arms furnished with microsetae posteriorly. Paraproct (Figs. 6d & 7a) of usual form. Cercus (Figs. 6e & 7b) 0.5 × as long as wide, with posterior border nearly straight when viewed laterally. Spermatheca ovoid, well sclerotized and with reticulate patterns on surface; tube and small area near tubal juncture unsclerotized; internal setae absent.

**Male.** Body length ca. 2.8 mm. *Head.* Wider than thorax. Upper eye consisting of 14 vertical columns and 15 horizontal rows of large facets. Clypeus brownish black, covered densely with yellow pubescence, interspersed with several dark hairs. Antenna composed of 2+9 segments, yellowish; 1st flagellomere elongate, 2.0 × as long as 2nd one. Maxillary palp with 5 segments; proportional lengths of 3rd, 4th and 5th segments 1.0:1.1:2.0; sensory vesicle globular, 0.2 × as long as 3rd segment, with a small opening. *Thorax.* As in ♀ except



Figs. 1-11. Adult characters of *Simulium (Morops) solomonense* sp. nov. 1, fronto-ocular area; 2, 3rd maxillary palpal segment showing a sensory vesicle; 3, cibarium; 4, distal tip of basitarsus and 2nd tarsal segment of hind leg showing calcipala (a) and pedisulcus (b); 5, claw with a small tooth; 6, genitalia in situ (ventral view) (a, 8th sternite; b, gonapophysis; c, genital fork; d, paraproct; e, cercus; f, spermatheca); 7, paraproct (a) and cercus (b) (side view); 8, coxite (a) and style (b) (ventral view); 9-11, ventral plate (9, ventral view; 10, side view; 11, end view). 1-7, ♀; 8-11, ♂.

pleural membrane with ca. 130 yellowish white pubescence interspersed with several dark hairs. *Legs*. Coloration as in ♀. Fore basitarsus somewhat dilated,  $6.3 \times$  as long as its greatest width. Hind basitarsus slender, almost parallel-sided,  $6.5 \times$  as long as wide. Hind femur and tibia ca.  $2.3 \times$  and  $1.8 \times$  width of hind basitarsus, respectively. Calcipala and pedisulcus well developed, as in ♀. All femora and tibiae densely covered with scale-like hairs on outer surface. *Wing*. Length 1.8 mm. Other features as in ♀ except subcosta bare. *Abdomen*. Basal scale brown, with fringe of dark hairs. Dorsal surface of abdominal segments brownish, covered with dark hairs; segments 2, 5-7 each with a dorsolateral pair of shiny patches. *Genitalia*. Coxite (Fig. 8a) much longer than wide. Style (Fig. 8b) shorter than coxite, tapered toward apex, and with an apical spine. Ventral plate (Figs. 9-11) transverse, much shorter than wide, concave posteriorly (in ventral view), fully setose on ventral surface but bare on posterior and dorsal surfaces; basal arms of moderate length, subparallel to each other. Paramere without hooks. Median sclerite transparent, probably wide.

**Pupa.** Body length (excluding gill filaments) ca. 2.8 mm.

*Head*. Integument dark yellow, bare with 4 pairs of trichomes, all long and simple. Antennal sheath with smooth surface. *Thorax*. Integument dark yellow, bare except posterodorsal surface very sparsely covered with tubercles; near base of gill there is on each side a large, circular pit-like organ (Fig. 12a) thickly fringed with distinct, comb-like processes (as in Fig. 20); *pl* ratio 1; thoracic trichomes 6 pairs (5 anterodorsally and 1 posterolaterally), all long and simple. Gill (Fig. 13) composed of 4 slender filaments, arising from very long basal stalk, subequal in length and thickness (total gill length ca. 2.0 mm); basal stalk with a large, transparent pouch, which expands laterally and ventrally (Figs. 12b & 13a); surface of distal 1/2 of basal stalk with many longitudinal and transverse ridges, covered with somewhat larger tubercles on ridges and with smaller ones on interspaces (Fig. 13b); slender filaments subequal in length and thickness, with well-defined annular ridges and furrows on their surface, and covered with rather larger tubercles on ridges and smaller ones on interspaces; all filaments dark yellow to yellowish brown. *Abdomen*. Terga 1 and 2 pale brown, without tubercles; tergum 1 with 1 long seta on each side, tergum 2 with 5 simple spinous setae and 1 much longer seta on each side. Terga 3 and 4 each with 4 hooked spines directed forward on each side. Terga 7-9 each with a transverse row of spine-combs and comb-like groups of minute spines directed caudad on each side, though spine-

combs on tergum 9 somewhat smaller than those on terga 7 and 8. Tergum 9 with distinct, cone-shaped, terminal hooks (Fig. 14). Sternum 4 with 1 distinct, simple hook and a few minute setae on each side; sternum 5 with a pair of bifid hooks on each side; sterna 6 and 7 each with a pair of inner bifid and outer simple hooks on each side; last segment without grapnel-like hooklets ventrolaterally on each side. *Cocoon*. Shoe-shaped, moderately woven, somewhat extending ventrolaterally; anterior margin not thickly woven; individual threads visible; interspaces thinly walled, but without perforations.

**Mature larva.** Body length 4.7-5.2 mm. Body grey to greyish black. Cephalic apotome pale yellow with a large dark brown area medially on posterior 1/2; head spots distinct, often merged in surrounding dark brown area. Antenna with 3 segments and apical sensillum, longer than stem of labral fan; proportional lengths of 3 segments from base to tip 1.0:1.0:0.7. Labral fan with ca. 44 main rays. Mandible (Fig. 15) with comb-teeth decreasing in size from 1st to 3rd; mandibular serration composed of 2 teeth (1 large and 1 small), with a few supernumerary serrations. Hypostomium (Fig. 16) with a row of 9 apical teeth; median tooth as long as each corner tooth, longer than 3 intermediate teeth on each side; lateral margin serrate; hypostomal bristles 7 in number per side, lying slightly divergent posteriorly from lateral margin. Postgenal cleft (Fig. 16) with lateral margins subparallel to each other on basal 1/2, with apex pointed, which often has a narrow extension anteriorly approaching posterior border of hypostomium. Thoracic cuticle bare. Abdominal cuticle bare except each side of anal sclerite of last segment moderately covered with numerous colorless setae. Rectal papilla compound, each of 3 lobes with 4 or 5 finger-like, secondary lobules on posterior surface. Anal sclerite (Fig. 17) of usual X-form, with anterior arms ca.  $0.7 \times$  as long as posterior ones, broadly sclerotized at base. Last abdominal segment expanded ventrolaterally forming double bulges on each side, visible as a small ventral papilla when viewed from side. Posterior circlet with ca. 104 rows of up to 16 hooklets per row.

**TYPE SPECIMENS.** Holotype ♀, reared from pupa, slide-mounted, collected from a stream, Noro, New Georgia Island, Western Province, Solomon Islands, 5. IX. 1992, by H. Suzuki. Allotype ♂, reared from pupa, slide-mounted, same data as holotype. Paratypes: 5 pupae and 4 pupal exuviae, same data as holotype; 1 pupa and 2 pupal exuviae and 11 mature larvae, same data as holotype except date: 21. II. 1993.

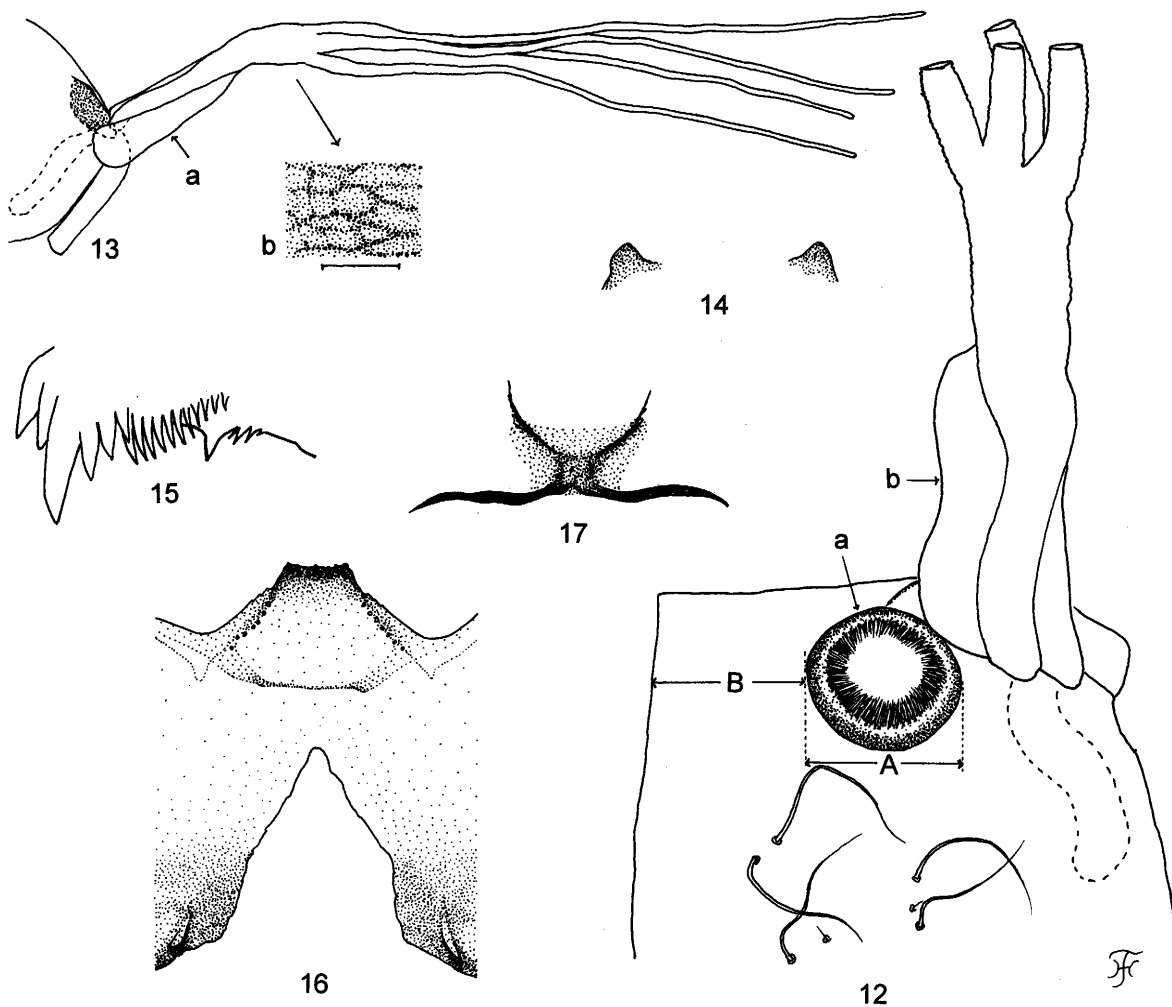
DISTRIBUTION. Solomon Islands (New Georgia Island).

REMARKS. This new species belongs to the *clathrinum*-group of the subgenus *Morops*, defined by Crosskey (1967) by having the pit-like organ (Fig. 12a), as well as four gill filaments. Among five known species, *S. (M.) clathrinum* from Australia (Mackerras and Mackerras, 1948) and *S. (M.) lalokiense* from central Papua New Guinea (Smart and Clifford, 1965) have a large, pit-like organ with comb-like processes along the inner margin (Figs. 18 & 19). The pit-like organ of this species is as large as that of *S. (M.) lalokiense* (*plo* ratio ca. 1.1) but somewhat larger than that of *S. (M.) clathrinum* (*plo*

ratio ca. 0.7). However, there are clear differences between this new species and the latter two known species. In the latter two species, the basal stalk is short, and there are tubercles along the middle longitudinal suture of the anterodorsal surface of thorax (Figs. 18 & 19).

### 3. *Simulium (Morops) pohaense* sp. nov.

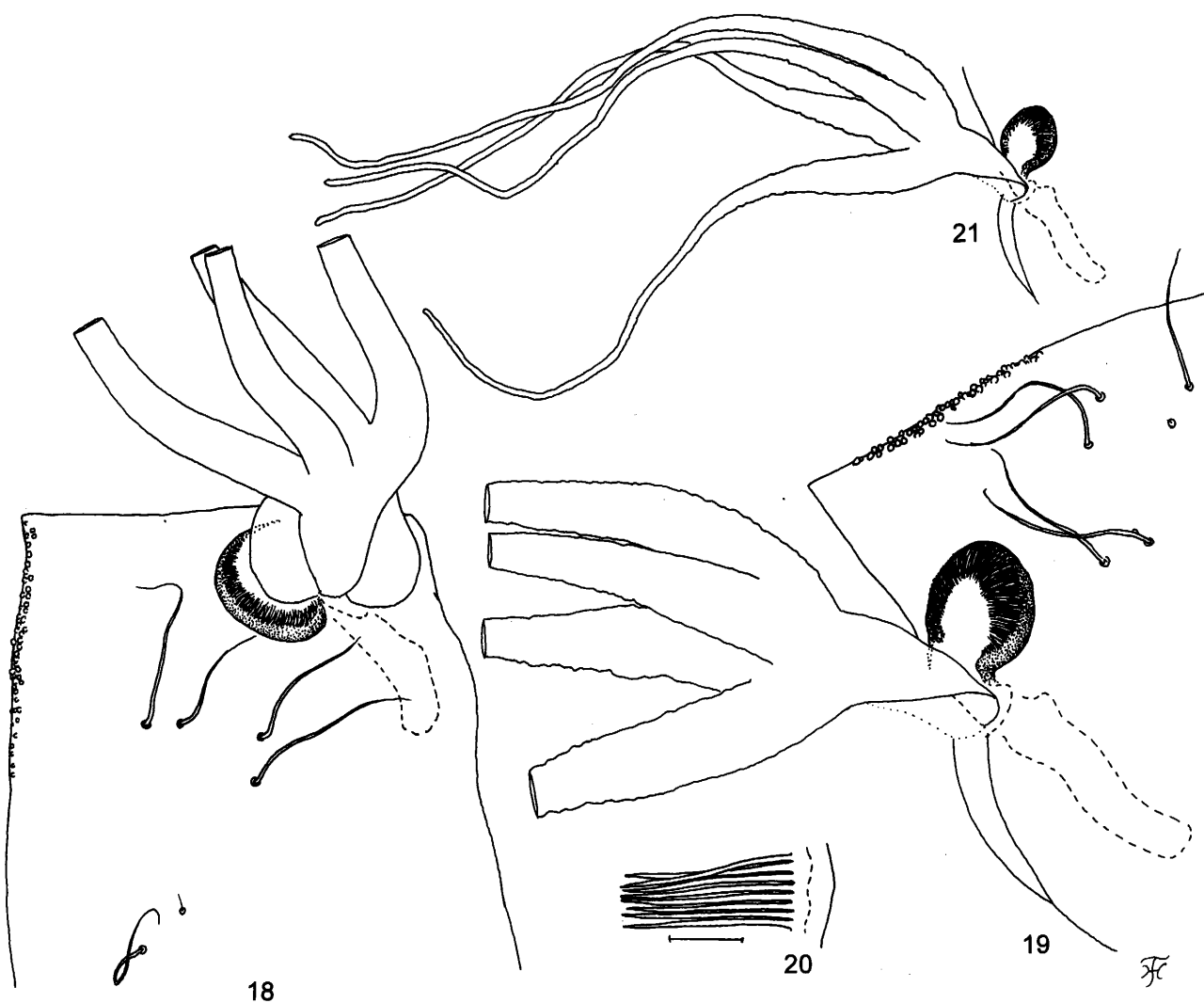
DESCRIPTION. **Female.** Body length ca. 2.5 mm. *Head.* Slightly narrower than thorax. Frons dark brown, white pruinose, densely covered with white, scale-like, recumbent pubescence, interspersed with several dark hairs along both lateral margins; frontal ratio 1.51:1.00:



Figs. 12-17. Pupal and larval characters of *Simulium (Morops) solomonense* sp. nov. 12-14, pupa; 15-17, larva. 12, anterior part of thorax (right half) showing a pit-like organ (a) and a transparent pouch (b) at the base of gill filaments (dorsal view); 13, gill filaments showing a transparent pouch (a) and surface sculpture on the basal stalk (b); 14, terminal hooks; 15, apical tip of mandible; 16, head capsule showing hypostomium and postgenal cleft; 17, anal sclerite. Scale bar 0.02 mm for Fig. 13b.

1.54. Frons-head ratio 1.0: 4.3. Fronto-ocular area (Fig. 22) well developed. Clypeus dark brown, densely covered with white, scale-like, recumbent pubescence interspersed with several dark hairs. Antenna composed of 2+9 segments, dark brown except scape, pedicel and base of 1st flagellomere yellow when viewed from top. Maxillary palp with 5 segments; proportional lengths of 3rd, 4th and 5th segments 1.0:1.1:2.1; 3rd segment somewhat enlarged, sensory vesicle (Fig. 23) ellipsoidal,  $1.7\times$  as long as wide,  $0.3\times$  as long as 3rd segment, with a medium opening near distal end. Maxillary lacinia

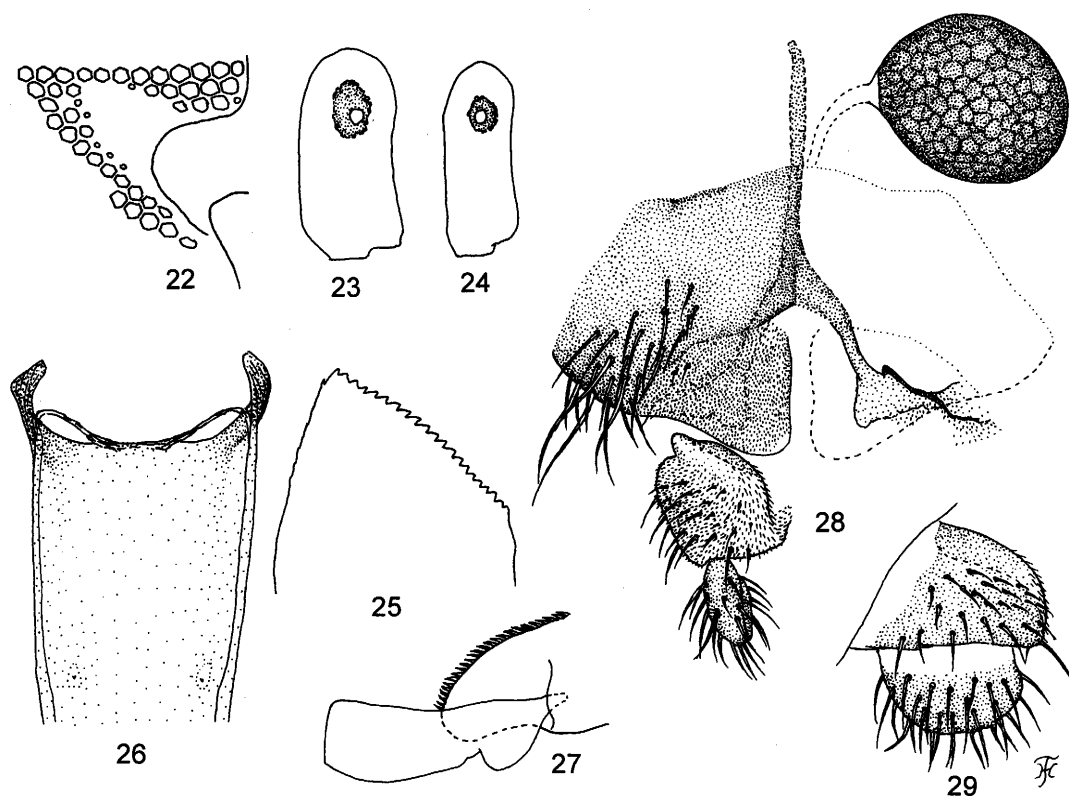
with 7 inner and 11 outer teeth. Mandible with 21 small inner teeth and 1 outer tooth near apex; outer margin near apex very slightly erose (Fig. 25). Cibarium (Fig. 26) with smooth posterior margin, which is covered with transparent, elongated projections extending from both arms. *Thorax*. Scutum dark brown in ground color, densely covered with white, recumbent pubescence except median, large area with dark brown pubescence; 3 longitudinal vittae of white recumbent pubescence (1 median vitta narrow and 2 submedian ones rather wide), which are connected anteriorly and posteriorly to areas



Figs. 18-21. Pupal characters of two species of the *clathrinum*-group. 18 & 19, anterior part of thorax showing a pit-like organ (18, dorsal view; 19, side view, slide-mounted); 20, comb-like processes along inner margin of pit-like organ; 21, gill filaments. 18, *S. (M.) clathrinum* (alcoholic specimen collected from North Queensland, Australia, 15. IX. 1949, by I. M. & M. J. Mackerras, BMNH); 19-21, *S. (M.) lalokiense* (allotype slide-mounted specimen collected from Central District, Papua New Guinea, 17. IX. 1957, by J. Smart, BMNH). Scale bar 0.02 mm for Fig. 20.

of the concolored pubescence; long, erect, dark hairs present on prescutellar area. Scutellum blackish brown with white pubescence and many, long, erect, dark hairs. Postscutellum blackish brown, bare. Pleural membrane with ca. 120 white pubescence and a few dark hairs. Katepisternum longer than deep, dark brown, with numerous white pubescence and dark hairs; sulcus distinct. *Legs.* Foreleg: coxa and trochanter pale greyish brown; femur pale brown; tibia brown with median, large portion somewhat lighter, white pubescence on outer surface silvery iridescent in certain angles of light; tarsus blackish brown; basitarsus dilated, ca.  $5.3\times$  as long as its greatest width; tarsal segments 1-3 moderately furnished with dorsal crest of dark brown, scale-like hairs. Midleg: coxa dark brown; trochanter pale greyish brown; femur greyish brown with apical cap brown; tibia brown with base yellow, white pubescence on posterior surface silvery iridescent in certain angles of light; tarsus brown to blackish brown. Hind leg: coxa and trochanter pale greyish brown; femur greyish brown with apical cap brown; tibia brownish with base yellow and apical  $1/4$  dark brown, white pubescence on poste-

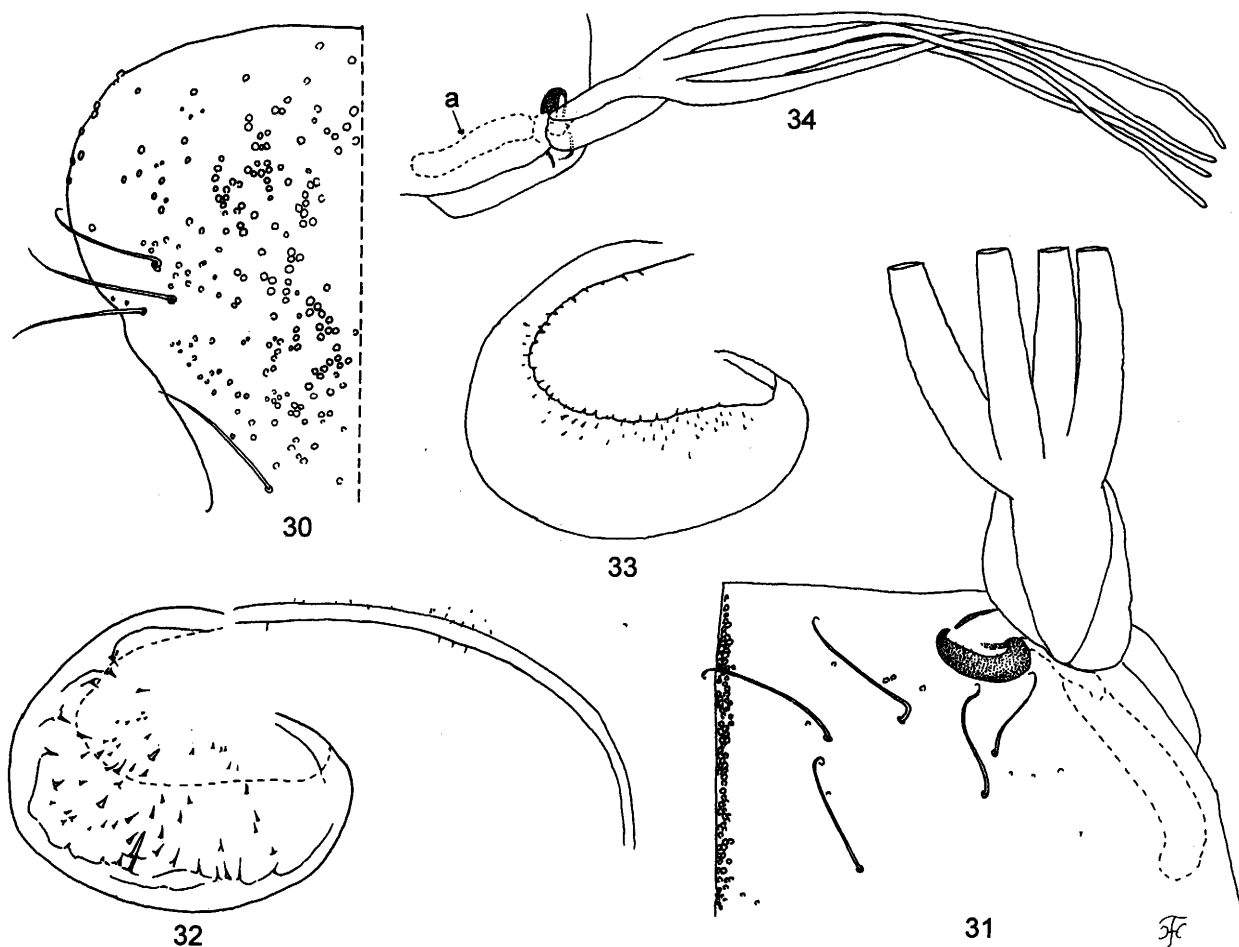
rior surface silvery iridescent in certain angles of light; tarsus dark brown with basal  $3/5$  of basitarsus and basal  $1/2$  of 2nd tarsomere white; basitarsus slender, parallel-sided, ca.  $7.2\times$  as long as wide. Calcipala (Fig. 27) well developed, ca.  $1.2\times$  as long as wide. Pedisulcus (Fig. 27) well developed. Hind femur and tibia  $2.3\times$  and  $1.7\times$  as wide as hind basitarsus, respectively. All femora and tibiae densely covered with scale-like hairs on outer surface. Claws each with a small basal tooth, similar to that of ♀ *S. (M.) solomonense*. *Wing.* Length 1.7 mm. Costa with spinules as well as hairs. Subcosta haired on basal  $3/5$ . Hair tuft on stem vein dark brown. Basal portion of radius fully haired. *Abdomen.* Basal scale brown with fringe of white hairs. Dorsal surface of segments 2-5 pale except tergites brown, very densely covered with scale-like, recumbent pubescence which is entirely shiny white on segment 2, and mostly dark brown (intermixed with white ones along posterior margin) on segments 3-5; that of segments 6-8 each with a large, dark brown tergite, moderately covered with white, recumbent pubescence, interspersed with dark hairs; tergites 2, 6-8 shiny; abdomen moderately



Figs. 22-29. Adult characters of *Simulium (Morops) pohaense* sp. nov. 22, fronto-ocular area; 23 & 24, 3rd maxillary palpal segment showing sensory vesicle; 25, mandible; 26, cibarium; 27, calcipala and pedisulcus; 28, genitalia in situ (ventral view); 29, paraproct and cercus (side view). 24, ♂; others, ♀.

covered with white, scale-like pubescence also laterally. *Genitalia* (Figs. 28 & 29). Sternal plate well developed on abdominal segment 7 and with ca. 50 hairs. Sternite 8 bare medially, with 24-26 macrosetae on each side. Anterior gonapophysis triangular, thin, membranous, covered densely with microsetae interspersed with a few setae; inner margin moderately sclerotized. Genital fork of usual inverted-Y form, with arms rather broad, folded medially, with a short projection directed forward; arms furnished with microsetae posteriorly. Paraproct of usual form. Cercus  $0.5 \times$  as long as wide, with posterior border rounded when viewed laterally. Spermatheca nearly globular, well sclerotized, with reticulate patterns on surface; tube and small area near tubal juncture unsclerotized; internal setae absent.

**Male.** Body length ca. 2.5 mm. *Head.* Wider than thorax. Upper eye consisting of 14 or 15 vertical columns and 13-15 horizontal rows of large facets. Clypeus brownish black, covered densely with whitish yellow pubescence, intermixed with many dark hairs. Antenna composed of 2+9 segments, pale brown, becoming darker apically except scape, pedicel and base of 1st flagellomere yellow; 1st flagellomere elongate,  $1.7 \times$  as long as 2nd one. Maxillary palp with 5 segments; proportional lengths of 3rd, 4th and 5th segments 1.00:1.03:2.00; sensory vesicle (Fig. 24) globular,  $0.2 \times$  as long as 3rd segment, with a medium opening. *Thorax.* As in ♀ except pubescence on scutum and scutellum yellowish; 3 longitudinal vittae of yellow pubescence on scutum not well defined. *Legs.* As in ♀ except following features:



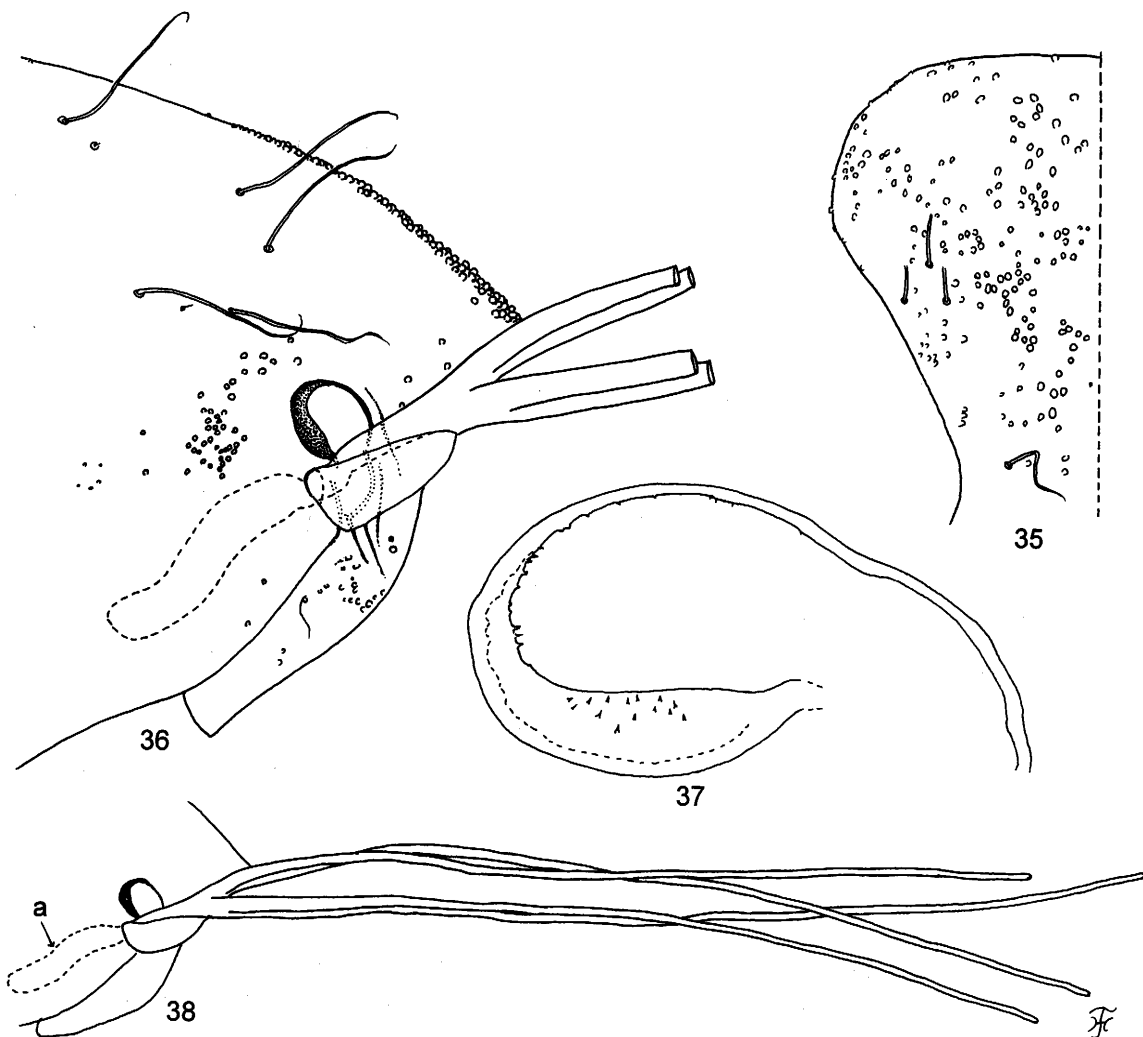
Figs. 30-34. Pupal characters of *Simulium (Morops) pohense* sp. nov. 30, frons (right half) showing 4 trichomes and scattered tubercles; 31, anterior part of thorax (right half) showing a pit-like organ, tubercles along middle longitudinal suture, five trichomes and basal portion of gill (dorsal view); 32, pit-like organ showing minute, spine-like processes on floor; 33, dorsal eaves-like wall of pit-like organ showing minute, spine-like processes on under surface and along inner margin; 34, gill filaments (side view) (a, interspiracular trunk).



fore basitarsus somewhat dilated,  $6.3 \times$  as long as its greatest width; hind basitarsus slender, almost parallel-sided,  $7.0 \times$  as long as wide; hind femur and tibia ca.  $2.1 \times$  and  $1.8 \times$  width of hind basitarsus, respectively. *Wing*. Length 1.6 mm. Other features as in ♀ except subcosta bare. *Abdomen and Genitalia*. As in ♂ of *S. (M.) solomonense*.

**Pupa.** Body length (excluding gill filaments) ca. 2.5 mm. *Head*. Integument dark yellow, bare or sparsely (moderately in some pupae, Fig. 30) covered with round tubercles, and with 4 pairs of trichomes, all long and simple. Antennal sheath with smooth surface. *Thorax*. Integu-

ment dark yellow, bare or very sparsely covered with round tubercles except posterodorsal surface moderately covered with smaller tubercles and both sides of middle longitudinal suture narrowly covered with round tubercles (Fig. 31); near base of gill there is on each side a medium-sized, pit-like organ sparsely covered with minute, spine-like processes on floor (Fig. 32) and on under surface and along inner margin of dorsal, eaves-like wall (Fig. 33); *pl* ratio variable from 0.31-0.53 (median = 0.43,  $n = 83$ ); thoracic trichomes 6 pairs (5 anterodorsally and 1 posterolaterally), all long and simple. Gill (Fig. 34) composed of 4 slender filaments,



Figs. 35-38. Pupal characters of *Simulium (Morops) avilae*. 35, frons (right half) showing four trichomes and scattered tubercles; 36, anterior part of thorax showing a pit-like organ, tubercles along middle longitudinal suture, five trichomes and basal portion of gill (side view, slide-mounted); 37, pit-like organ showing minute, spine-like processes on under surface and along inner margin; 38, gill filaments (side view) (a, interspiracular trunk). (Examined was the paratype slide-mounted specimen collected in Northern District, Papua New Guinea, 19. I. 1958, by J. Smart, BMNH)

arising from long basal stalk, sessile or short-stalked, subequal in length and thickness (total gill length 1.5–2.3 mm, average ca. 1.8 mm); basal stalk with a large, transparent pouch, which expands laterally; each filament rather thick basally, nearly as thick as interspiracular trunk (Fig. 34a), tapered gradually to mid point, then nearly of the same diameter up to apical tip; surface of each filament with well-defined, annular ridges forming polygonal patterns, covered with somewhat larger tubercles on ridges and with smaller ones on interspaces; all filaments dark yellow to yellowish brown. *Abdomen* and *Cocoon*. As in *S. (M.) solomonense* except tergum 9 lacking spine-combs.

**Mature larva.** As in *S. (M.) solomonense* except following features: Body length 4.3–5.0 mm. Cephalic apotome pale yellow with a large, dark brown area medially on posterior 1/2 with head spots distinct, often merged in surrounding dark brown area, or cephalic apotome entirely pale yellow with positive head spots, at least middle longitudinal spot. Proportional lengths of 3 antennal segments from base to tip 1.0:1.0:0.6. Labral fan with 36–42 main rays. Hypostomal bristles 6 in number per side. Rectal papilla compound, each of 3 lobes with 3 or 4 finger-like, secondary lobules on posterior surface. Posterior circlet with 92–100 rows of up to 15 hooklets per row.

**TYPE SPECIMENS.** Holotype ♀, reared from pupa, slide-mounted, collected from Poha River, Guadalcanal Island, Solomon Islands, 15. VIII. 1993, by H. Suzuki. Allotype ♂, reared from pupa, slide-mounted, same data as holotype. Paratypes: 2 ♀, 5 ♂, all reared from pupa, 23 pupae, 10 pupal exuviae, 5 mature larvae, all in alcohol except 2 pupal exuviae and 3 mature larvae slide-mounted, same data as holotype. Other specimens: 5 ♀, 7 ♂, all reared from pupa, 15 pupae, 33 pupal exuviae and 17 mature larvae, collected from Tenaru River, Guadalcanal Island, 10. VIII. 1992, by H. Suzuki; 8 ♀, 3 ♂, all reared from pupa, 18 pupae and 13 pupal exuviae, collected from Tenaru River, Guadalcanal Island, 16. VIII. 1992, by H. Suzuki; 26 ♀, 13 ♂, all reared from pupa, 49 pupae, 13 pupal exuviae and 3 mature larvae, collected from Tanatita River, Guadalcanal Island, 16. VIII. 1992, by H. Suzuki; 1 ♀, reared from pupa, and 4 pupae, collected at Gold Ridge, Guadalcanal Island, 30. VIII. 1992, by H. Suzuki.

**DISTRIBUTION.** Solomon Islands (Guadalcanal Island).

**REMARKS.** This new species also belongs to the *clath-*

*rinum*-group by having the pit-like organ (Fig. 31), as well as four gill filaments. The pit-like organ of this species differs in size from one pupa to another, then *plo* ratio also varies from 0.31 to 0.53 with a median of 0.43. Among five known species of the *clathrinum*-group, *S. (M.) avilae* from Northern District, Papua New Guinea (Smart and Clifford, 1965) has a similar pit-like organ of which *plo* ratio is 0.45 (measured from two slide-mounted specimens loaned from BMNH). However, *S. (M.) pohaense* is separated from *S. (M.) avilae* by having the somewhat inflated base of each gill filament (Fig. 34) which is as thick as interspiracular trunk (much thinner in the latter species, see Fig. 38), and by the presence of spinous processes on the floor of the pit-like organ (Fig. 32) (absent in the latter species although there are several processes on the dorsal wall, as seen in Fig. 37).

#### 4. *Simulium (Morops) selwynense* sp. nov.

**DESCRIPTION. Female.** Unknown.

**Male.** As in ♂ of *S. (M.) pohaense* except following features: Body length ca. 2.2 mm. *Head.* Wider than thorax. Upper eye consisting of 12 vertical columns and 13 horizontal rows of large facets. Sensory vesicle nearly globular,  $0.21 \times$  as long as 3rd segment, with a small opening medially. *Thorax.* Pleural membrane with ca. 100 yellowish white pubescence interspersed with a few dark hairs. *Legs.* Fore basitarsus somewhat dilated,  $5.8 \times$  as long as its greatest width. Hind basitarsus slender, almost parallel-sided,  $7.0 \times$  as long as wide. Hind femur and tibia ca.  $2.1 \times$  and  $1.7 \times$  width of hind basitarsus, respectively. *Wing.* Length 1.5 mm.

**Pupa.** Body length (excluding gill filaments) 2.5–2.8 mm. *Head.* Integument dark yellow, densely covered with round tubercles, and with 4 pairs of trichomes, all long and simple (Fig. 39). Antennal sheath with smooth surface. *Thorax.* Integument dark yellow, densely covered with round tubercles except anterior surface bare or sparsely covered with tubercles (Fig. 40); near base of gill there is on each side a medium-sized, pit-like organ (Fig. 40), similar to that of *S. (M.) pohaense*; *plo* ratio 0.45; thoracic trichomes 6 pairs (5 anterodorsally and 1 posterolaterally), all long and simple. Gill (Fig. 41) nearly as in *S. (M.) pohaense*. *Abdomen* and *Cocoon.* As in *S. (M.) solomonense* except terga 6–8 each with a transverse row of spine-combs though 1 or 2 in number on tergum 6.

**Mature larva.** As in *S. (M.) solomonense* except following features: Body length 4.0–4.2 mm. Proportional lengths of 3 antennal segments from base to tip 1.0:1.1:

0.7. Labral fan with ca. 37 main rays. Hypostomal bristles 6 in number per side. Rectal papilla compound, each of 3 lobes with 3 or 4 finger-like, secondary lobules on posterior surface. Posterior circlet with 85-88 rows of up to 14 hooklets per row.

**TYPE SPECIMENS.** Holotype ♂, reared from pupa, slide-mounted, collected from a stream at Selwyn College, Guadalcanal Island, Solomon Islands, 12. VIII. 1993, by H. Suzuki. Paratypes: 8 pupae and 7 pupal exuviae and 5 mature larvae, all in alcohol, same data as holotype. Other specimens: 3 pupal exuviae, collected from Tenaru River, Guadalcanal Island, 10. VIII. 1992, by H. Suzuki; 3 pupae and 2 pupal exuviae, in alcohol, collected Tanatita River, Guadalcanal Island, 16. VIII. 1992, by H. Suzuki; 1 pupal exuvia, in alcohol, collected at Gold Ridge, Guadalcanal Island, 30. VIII. 1992, by H.

Suzuki.

**DISTRIBUTION.** Solomon Islands (Guadalcanal Island).

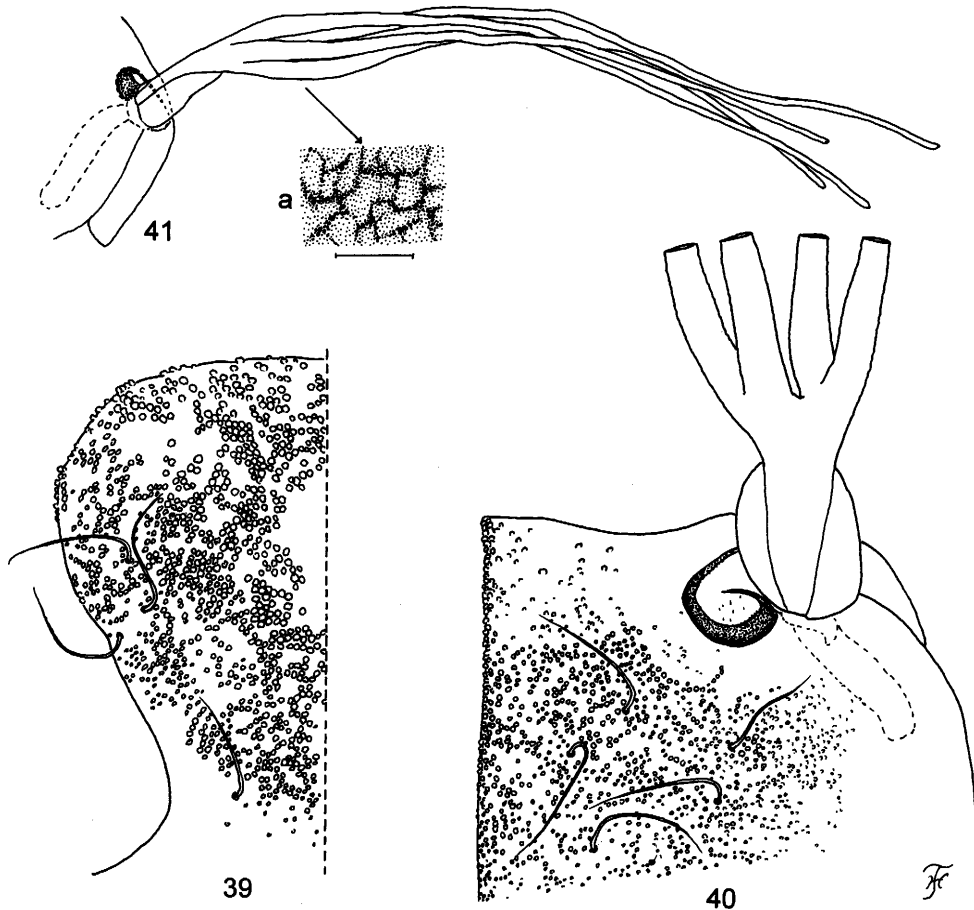
**REMARKS.** This new species resembles *S. (M.) pohaense* in many features including the pit-like organ and the gill filaments of the pupa. However this species differs from the latter species by the head and thoracic integument densely covered with tubercles (Fig. 40), which also separates it from *S. (M.) avilae*.

**5. *Simulium (Morops) kawagishii* sp. nov.**

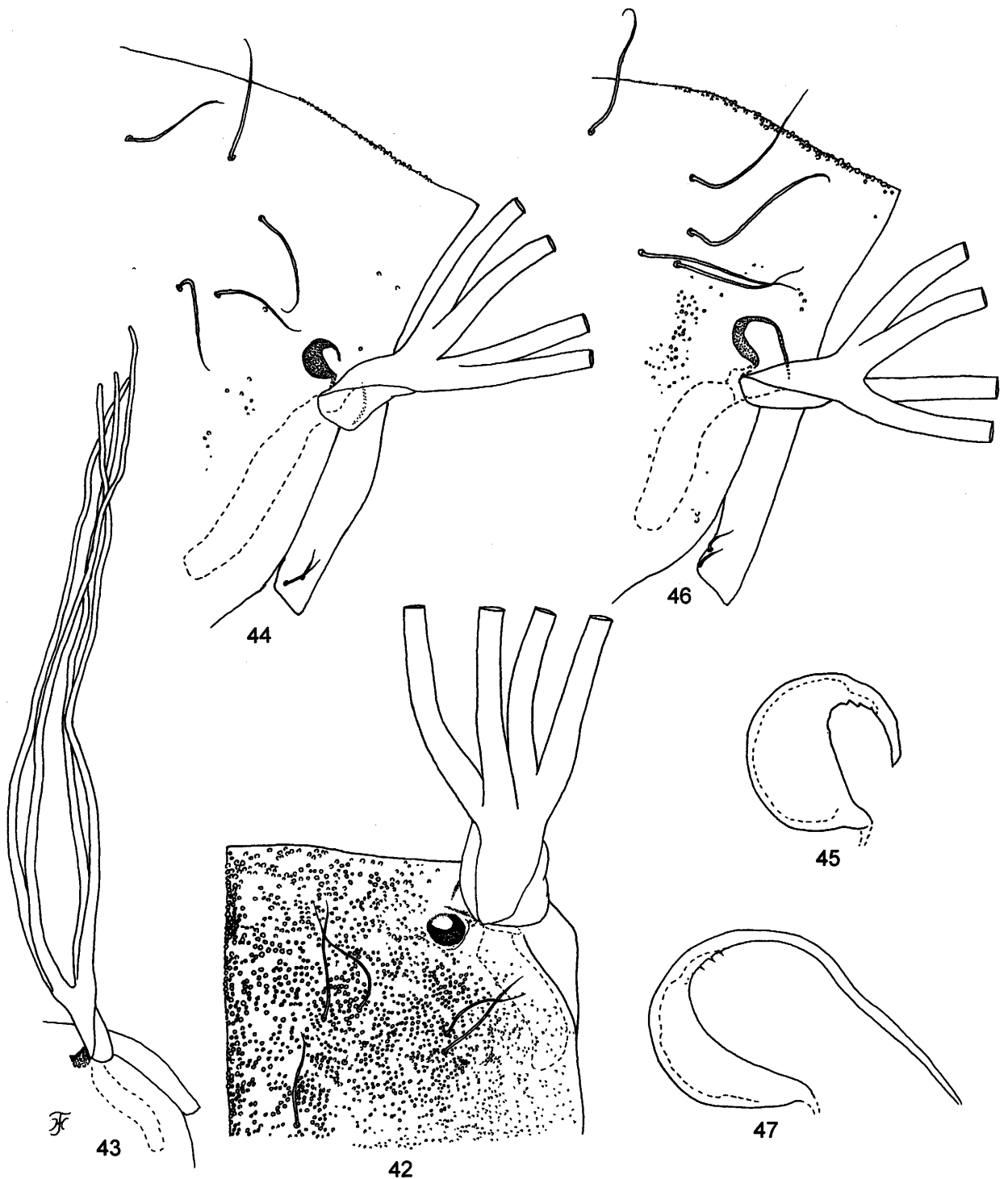
**DESCRIPTION. Female and Male.** Unknown.

**Pupa.** Body length (excluding gill filaments) ca. 2.5 mm.

**Head.** Integument dark yellow, densely covered with



Figs. 39-41. Pupal characters of *Simulium (Morops) selwynense* sp. nov. 39, frons (right half) showing four trichomes and dense tubercles; 40, anterior part of thorax (right half) showing a pit-like organ, five trichomes, dense tubercles and basal portion of gill filaments (dorsal view); 41, gill filaments showing surface sculpture near base of each filament (a). Scale bar 0.02 mm for Fig. 41a.



Figs. 42-47. Pupal characters of *Simulium (Morops) kawagishii* sp. nov. and two related species. 42, 44 & 46, anterior part of thorax showing a pit-like organ, five trichomes, distribution of tubercles and basal portion of gill filaments (42, dorsal view; 44 & 46, side view, slide-mounted); 43, gill filaments (side view); 45 & 47, pit-like organ. 42 & 43, *S. (M.) kawagishii*; 44 & 45, *S. (M.) raunsiimnae* (paratype slide-mounted specimen collected from New Britain, 14. XI. 1957, by J. Smart, BMNH); 46 & 47, *S. (M.) gagiduense* (paratype slide-mounted specimen collected from Morobe District, Papua New Guinea, 11-13. I. 1958, by J. Smart, BMNH).

round tubercles, and with 4 pairs of trichomes, all long and simple. Antennal sheath with smooth surface. *Thorax*. Integument dark yellow, densely covered with round tubercles (Fig. 42); near base of gill there is on each side a small, circular, pit-like organ (Fig. 42); *plo* ratio 0.25; thoracic trichomes 6 pairs (5 anterodorsally and 1 posterolaterally), all long and simple. Gill (Fig. 43) composed of 4 slender filaments, arising from long basal stalk, sessile or short-stalked, subequal in length and thickness (total gill length 1.8–2.0 mm); basal stalk with a transparent pouch, which expands laterally to some extent; each filament not so thick basally, much thinner than interspiracular trunk, tapered gradually to mid point, then nearly of the same diameter up to apical tip; surface of each filament with well-defined, annular ridges forming polygonal patterns near base, covered with somewhat larger tubercles on ridges and with smaller ones on interspaces; all filaments yellow. *Abdomen and Cocoon*. As in *S. (M.) pohaense*.

**Mature larva.** As in *S. (M.) solomonense* except following features: Body length 4.0–4.5 mm. Body greyish yellow. Cephalic apotome pale yellow with a large dark brown area medially on posterior 1/2 with head spots distinct, often merged in surrounding dark brown area or cephalic apotome entirely pale yellow with indistinct or distinct head spots. Labral fan with ca. 36 main rays. Hypostomal bristles 6 in number per side. Rectal papilla compound, each of 3 lobes with 3–5 finger-like, secondary lobules. Posterior circlet with 82–88 rows of up to 14 hooklets per row.

**TYPE SPECIMENS.** Holotype pupa, slide-mounted, collected from Danf River, Guadalcanal Island, Solomon Islands, 2. IX. 1992, by H. Suzuki. Paratypes: 2 pupae and 11 mature larvae, same data as holotype.

**DISTRIBUTION.** Solomon Islands (Guadalcanal Island).

**REMARKS.** The species name *kawagishii* is given after Mr. N. Kawagishi, ex chargé d'affaires to Solomon, who kindly helped HS during his stays in the Solomon Islands.

This new species also belongs to the *clathrinum*-group by having the pit-like organ (Fig. 42), as well as four gill filaments. The small pit-like organ (*plo* ratio 0.25) of this species separates it from the three preceding new species. Among five known species of this species-group, *S. (M.) raunsimnae* from New Britain Island and *S. (M.) gagiduense* from Morobe District of Papua New Guinea (Smart and Clifford, 1965) have a

closer value of *plo* ratio, 0.2 and 0.26–0.29, respectively (see Figs. 44 & 46). However, *S. (M.) kawagishii* differs from both species by the thoracic integument densely covered with tubercles (almost bare or sparsely covered with tubercles in the latter species, as seen in Figs. 44 & 46).

(B) *papuense*-group

6. *Simulium (Morops) papuense* Wharton, 1948

*Simulium papuensis* Wharton, 1948: 357–66.

*Simulium papuense*: Mackerras and Mackerras, 1949: 372–405; Mackerras and Mackerras, 1950: 167–87; Smart and Clifford, 1965: 591.

*Simulium (Morops) papuense*: Crosskey, 1967: 44; Crosskey, 1988: 457; Crosskey, 1989: 225.

This species was originally described from Papua New Guinea, based on the female, male, pupal and mature larval specimens (Wharton, 1948). The pupa is distinctive among *Morops* species by the gill of dendroid type (i.e., with ca. 30 slender filaments), and the larva, by the deep postgenal cleft reaching the posterior border of the hypostomium. Crosskey (1967) erected the *papuense*-group for this unique species. In our larval specimens of *S. (M.) papuense* it is also found that the abdominal segments 1–5 each have a dorsolateral pair of protuberances, a character not mentioned in the original description of *S. (M.) papuense* (Wharton, 1948). This is the first record of this species from the Guadalcanal Island.

**SPECIMENS EXAMINED.** 1 ♀ reared from pupa, 1 pupa and 7 mature larvae, collected from a slow stream, Babe, Guadalcanal Island, Solomon Islands, 6, III. 1992, by H. Suzuki.

**DISTRIBUTION.** Papua New Guinea and Solomon Islands (Guadalcanal Island) (new record).

(C) ungrouped species

7. *Simulium (Morops) sherwoodi* Stone and Maffi, 1971

*Simulium sherwoodi* Stone and Maffi, 1971: 299–300.

*Simulium (Morops) sherwoodi*: Crosskey, 1988: 458; Crosskey, 1989: 225.

This species was originally described based on the

adult female, male and pupal specimens collected from Guadalcanal Island, Solomon Islands, (Stone and Maffi, 1971). The adult female, male and pupa of *S. (M.) sherwoodi* are here redescribed, and the mature larva is described for the first time. It is clarified that the female tarsal claws have a minute basal tooth (not simple as mentioned in the original description). Further, the pupae show a transverse row of spine-combs dorsally on the segments 6 to 9 (not segments 5 to 8) and four hooks ventrally on segments 5 to 7 (not segments 6 to 8).

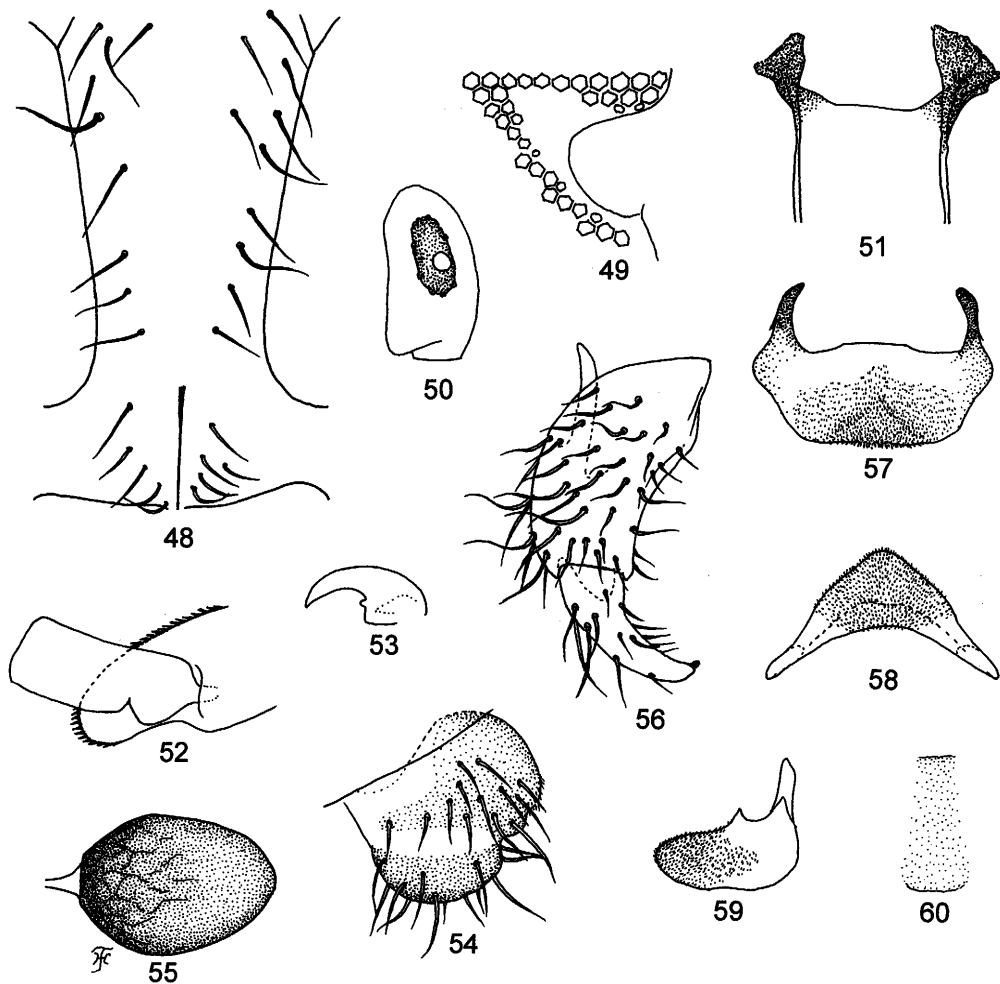
**REDESCRIPTION. Female.** Body length ca. 2.5 mm. *Head.* Slightly narrower than thorax. Frons (Fig. 48) dark brown, shiny, covered with several yellowish white hairs near lower margin and several dark hairs along both lateral margins, without scale-like, recumbent pubescence; frontal ratio 1.6:1.0:2.1. Frons-head ratio 1.0:5.6. Fronto-ocular area (Fig. 49) well developed. Clypeus dark brown, densely covered with yellowish white and dark hairs interspersed with whitish yellow, scale-like, recumbent pubescence on lower 1/2. Antenna composed of 2+9 segments, brownish black except scape, pedicel and base of 1st flagellar segment yellowish. Maxillary palp with 5 segments; proportional lengths of 3rd, 4th and 5th segments 1.0:1.1:2.4; 3rd segment somewhat enlarged, sensory vesicle (Fig. 50) elongate, 2.1 × as long as wide, 0.4 × as long as 3rd segment, with a medium opening slightly distally. Maxillary lacinia with 9 or 10 inner and 12 or 13 outer teeth. Mandible with ca. 25 small inner teeth and lacking outer ones. Cibarium (Fig. 51) smooth. *Thorax.* Scutum blackish brown in ground color, whitish grey pruinose, densely covered with whitish yellow or yellow, scale-like, recumbent pubescence except median large area with brown pubescence. Scutellum blackish brown with dark, scale-like, recumbent pubescence and long, erect, dark hairs along posterior margin. Postscutellum blackish brown, whitish grey pruinose (shining in light), bare. Pleural membrane with ca. 25 yellowish white pubescence. Katepisternum longer than deep, dark brown, whitish grey pruinose (shining in light), with numerous dark hairs and yellowish white pubescence; sulcus distinct. *Legs.* Foreleg: coxa and trochanter whitish yellow; femur dark yellow to pale brown; tibia white with distal 1/4 brownish black, outer surface widely white shining when illuminated; tarsus black; basitarsus somewhat dilated, ca. 4.7 × as long as its greatest width. Midleg: coxa brown; trochanter whitish yellow; femur yellow; tibia whitish yellow on basal 2/5, brown on rest; posterior surface of tibia widely white shining when illuminated; tarsus brown. Hind leg: coxa yellowish brown or pale

brown; trochanter yellowish white; femur dark yellow to yellowish brown with apical cap brown; tibia white on basal 3/5, brown to brownish black on distal 2/5; posterior surface of tibia widely white shining when illuminated; tarsus brown with basal 3/5 of basitarsus and basal 1/2 of 2nd tarsomere white; basitarsus slender, parallel-sided, ca. 6.9 × as long as wide. Calcipala (Fig. 52) well developed, ca. 1.2 × as long as wide. Pedisulcus (Fig. 52) well developed. Hind femur and tibia 2.2 × and 1.7 × as wide as hind basitarsus, respectively. All femora and tibiae densely covered with scale-like hairs on outer surface. Claws (Fig. 53) each with a minute basal tooth. *Wing.* Length 1.5 mm. Costa with spinules as well as hairs. Subcosta haired. Hair tuft on stem vein dark brown. Basal portion of radius fully haired. *Abdomen.* Basal scale brown with fringe of yellowish white hairs. Dorsal surface of abdomen black, with dark hairs; tergite of 2nd segment whitish pruinose, tergites of segments 5-8 shiny. *Genitalia.* Nearly as in *S. (M.) noroense* sp. nov. (Fig. 71). Sternal plate undeveloped on abdominal segment 7. Sternite 8 bare medially, with 12-13 dark macrosetae on each side. Anterior gonapophysis triangular, thin, membranous, covered densely with microsetae interspersed with a few setae; inner margin well sclerotized. Genital fork of usual inverted-Y form, with arms rather broad, folded medially, each with a small projection directed forward. Paraproct (Fig. 54) of usual form. Cercus (Fig. 54) ca. 0.5 × as long as wide, with posterior border gently rounded when viewed laterally. Spermatheca (Fig. 55) ovoid, well sclerotized except tube and tubal base unsclerotized; internal setae present.

**Male.** Body length ca. 2.5 mm. *Head.* Wider than thorax. Upper eye consisting of 9 or 10 vertical columns and 11-13 horizontal rows of large facets. Clypeus brownish black, whitish pruinose, covered densely with yellow pubescence, interspersed with dark hairs. Antenna composed of 2+9 segments, yellow with 6 apical segments brown; 1st flagellomere somewhat elongate, ca. 1.6 × as long as 2nd one. Maxillary palp with 5 segments; proportional lengths of 3rd, 4th and 5th segments 1.0:1.2:2.9; sensory vesicle oblong, 0.33 × as long as 3rd segment, with opening near distal end. *Thorax.* Nearly as in ♀ except pleural membrane with ca. 15 hairs. *Legs.* Foreleg: coxa and trochanter yellow; femur yellow with distal 1/3 brown; tarsus brownish black; basitarsus somewhat dilated ca. 5.0 × as long as its greatest width. Midleg: coxa dark brown; trochanter and femur yellow; tibia brown with basal 1/4 yellow; tarsus brown. Hind leg: coxa dark yellow; trochanter yellow; femur yellow, somewhat darkened toward distal

end, with distal cap brown; tibia yellow on basal 1/2, brown to brownish black on distal 1/2; tarsus brown to brownish black except basal 3/5 of basitarsus and basal 1/2 of 2nd tarsomere yellow; basitarsus slender, parallel-sided, ca.  $5.6 \times$  as long as wide. Hind femur and tibia subequal in greatest width, ca.  $1.8 \times$  as wide as hind basitarsus. Calcipala well developed, ca.  $1.2 \times$  as long as wide. Pedisulcus well developed. All femora and tibiae densely covered with scale-like hairs on outer surface. *Wing*. Length 1.5 mm. Other features as in ♀ except subcosta bare. *Abdomen*. Basal scale brown, with fringe of brown hairs. Dorsal surface of abdominal segments brownish black, covered with dark hairs; segments 2, 5-7 each with a dorsolateral pair of shiny, whitish pruinose patches; those on segment 2 widely

connected in middle. *Genitalia*. Coxite (Fig. 56) nearly rectangular in ventral view, much longer than wide. Style (Fig. 56) shorter than coxite, tapered toward apical tip, gently curved inward, with apical spine. Ventral plate (Figs. 57-59) transverse, ca.  $0.4 \times$  as long as wide, with both sides much angulated, widely produced ventrally along posterior margin, with microsetae on ventral, posterior and dorsal surface; basal arms converging. Paramere with 3 long hooks and several small ones (nearly as in *S. (M.) noroense* sp. nov., Fig. 76). Median sclerite (Fig. 60) weakly sclerotized, plate-like, slightly widened toward tip, with round tip. *Pupa*. Body length (excluding gill filaments) ca. 2.5 mm. *Head*. Integument yellowish brown, moderately covered with round tubercles; a pair of facial trichomes and 2

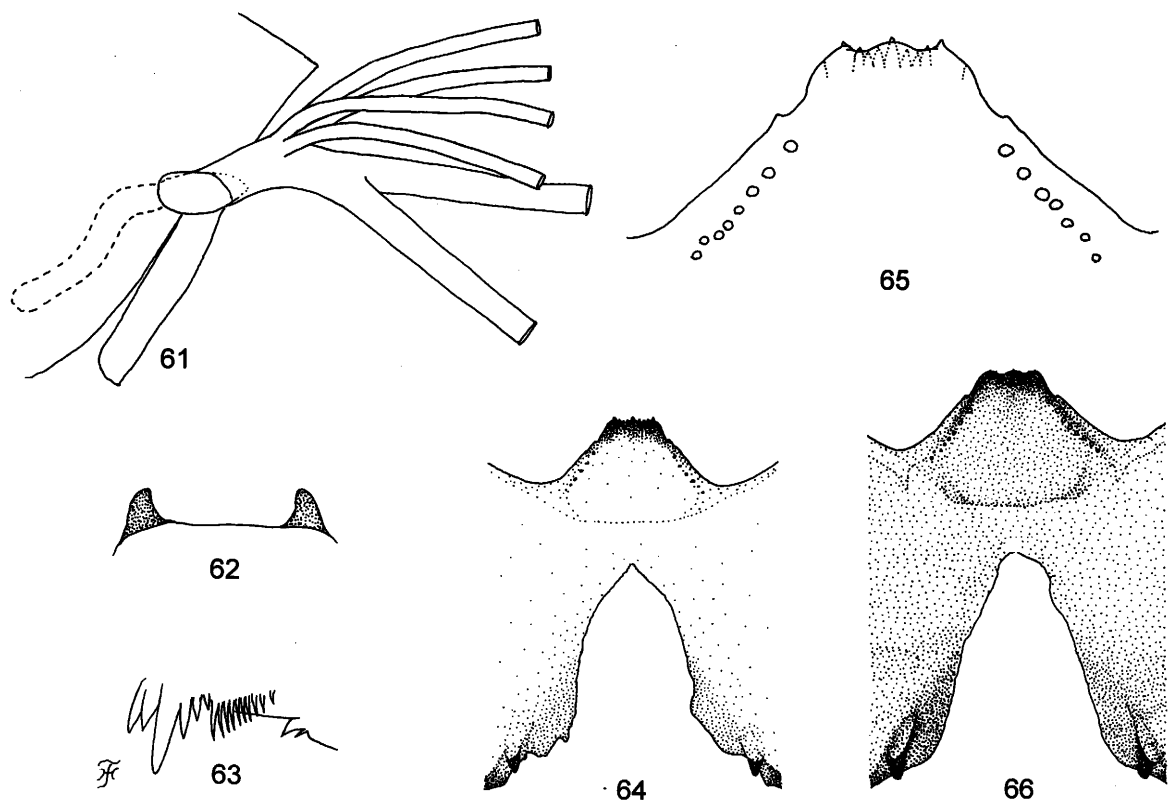


Figs. 48-60. Adult characters of *Simulium (Morops) sherwoodi*. 48, frons; 49, fronto-ocular area; 50, 3rd maxillary palpal segment; 51, cibarium; 52, calcipala and pedisulcus; 53, claw with a minute tooth; 54, paraproct and cercus (side view); 55, spermatheca; 56, coxite and style (ventral view); 57-59, ventral plate (57, ventral view; 58, end view; 59, side view); 60, median sclerite. 48-55, ♀; 56-60, ♂.

pairs of frontal trichomes all long and bifid. Antennal sheath with smooth surface. *Thorax*. Integument yellowish brown, bare except anterior surface moderately covered with round tubercles and posterodorsal surface moderately covered with small, cone-shaped tubercles; 5 anterodorsal pairs of trichomes all long and bifid, 1 posterolateral pair long and simple. Pit-like organ absent. Gill (Fig. 61) composed of paired ventral filaments and 4 much slender dorsal filaments arising from basal stalk of paired filaments; paired filaments subequal in length (2.5-3.0 mm) and thickness, lying horizontally, parallel-sided or somewhat diverging, directing forwards and tapered toward apical tip; surface of paired filaments with many transverse ridges (except apical portion) forming reticulate patterns, covered with somewhat larger tubercles on ridges and with smaller ones on interspaces; 4 slender filaments arranged in pairs with variable lengths of stalks (usually sessile or very short-stalked, but in one pupa secondary stalks very long, ca. 1 mm long), subequal in length (1.5-1.8 mm) and thickness, with weak annular ridges and furrows on their surface of basal 1/3, and covered with

minute tubercles. *Abdomen*. Terga 1 and 2 pale yellowish brown, without tubercles; tergum 1 with 1 long seta on each side, tergum 2 with 5 simple spinous setae and 1 much longer seta on each side. Terga 3 and 4 each with 4 hooked spines directed forward on each side. Terga 6-9 each with a transverse row of spine-combs and comb-like groups of minute spines directed caudad on each side. Tergum 9 with a pair of spatulate, terminal hooks (Fig. 62). Sternum 4 with 1 bifid hook and 1 simple hook (or spinous seta in some pupae) and 2 slender simple setae on each side; sternum 5 with a pair of bifid or trifid hooks on each side; sterna 6 and 7 each with a pair of inner bifid or trifid and outer simple or bifid hooks on each side; last segment without grapnel-like hooklets ventrolaterally on each side. *Cocoon*. Wall-pocket-shaped, moderately woven, widely extending ventrolaterally; anterior margin thickly woven; individual threads visible; interspaces thinly walled, without perforations.

**Mature larva.** Body length 3.6-4.2 mm. Body usually greyish, coloring on thorax and abdominal segment 3 weak and much paler than others. Cephalic apotome



Figs. 61-66. Pupal and larval characters of *Simulium (Morops) sherwoodi* and *S. (M.) kerei*. 61 & 62, pupa; 63-66, larva. 61, basal portion of gill filaments (side view); 62, terminal hooks (end view); 63, apex of mandible; 64 & 66, head capsule (ventral view) showing hypostomium and postgenal cleft; 65, hypostomium. 61-64, *S. (M.) sherwoodi*; 65 & 66, *S. (M.) kerei*.



pale yellow with faint, positive head spots. Antenna with 3 segments and apical sensillum, longer than stem of labral fan; proportional lengths of 3 segments from base to tip 1.0:0.7:1.0. Labral fan with ca. 36 main rays. Mandible (Fig. 63) with comb-teeth decreasing in size from 1st to 3rd; mandibular serration composed of 2 teeth (1 large and 1 small), without supernumerary serrations. Hypostomium (Fig. 64) with a row of 9 apical teeth, of which median tooth subequal to or slightly longer than each corner tooth; 6 intermediate teeth subequal in size to each other, and much smaller than corner teeth; lateral margin not serrate; hypostomal bristles 6 in number per side lying slightly divergent posteriorly from lateral margin. Postgenal cleft (Fig. 64) nearly triangular, gradually narrowed anteriorly, ca.  $5.0 \times$  as long as postgenal bridge (in some larvae anterior tip with a narrow extension approaching to posterior margin of hypostomium). Thoracic cuticle bare. Abdominal cuticle bare except each side of anal sclerite of last segment moderately covered with numerous colorless setae. Rectal papilla compound, each of 3 lobes with 1 or 2 finger-like, secondary lobules on posterior surface. Anal sclerite of usual X-form, with anterior arms ca.  $0.8 \times$  as long as posterior ones, broadly sclerotized at base. Ventral papillae present. Posterior circlet with 82 rows of up to 14 hooklets per row.

**SPECIMENS EXAMINED.** 9 ♀, 11 ♂, all reared from pupa, 52 pupae, 4 pupal exuviae and 29 mature larvae, all in alcohol, collected from a stream, Selwyn College, Guadalcanal Island, 12. VIII. 1993, by H. Suzuki; 4 pupae, 3 pupal exuviae and 5 mature larvae, all in alcohol, collected from Poha River, Guadalcanal Island, 15. VIII. 1993, by H. Suzuki; 2 ♂, both reared from pupa, 12 pupae, 1 pupal exuvia and 21 mature larvae, all in alcohol, collected from Tenaru River, Guadalcanal Island, 10. VIII. 1992, by H. Suzuki; 2 ♀, 5 ♂, all reared from pupa, 20 pupae, 2 pupal exuviae and 21 mature larvae, all in alcohol, collected from Tenaru River, Guadalcanal Island, 16. VIII. 1992, by H. Suzuki; 1 pupa and 18 mature larvae, all in alcohol, collected from Gold Ridge River, Guadalcanal Island, 30. VIII. 1992, by H. Suzuki; 5 ♀, 4 ♂, all reared from pupa, 41 pupae, 6 pupal exuviae and 8 mature larvae, all in alcohol, collected from Tanatita River, Guadalcanal Island, 16. VIII. 1992, by H. Suzuki.

**DISTRIBUTION.** Solomon Islands (Guadalcanal Island).

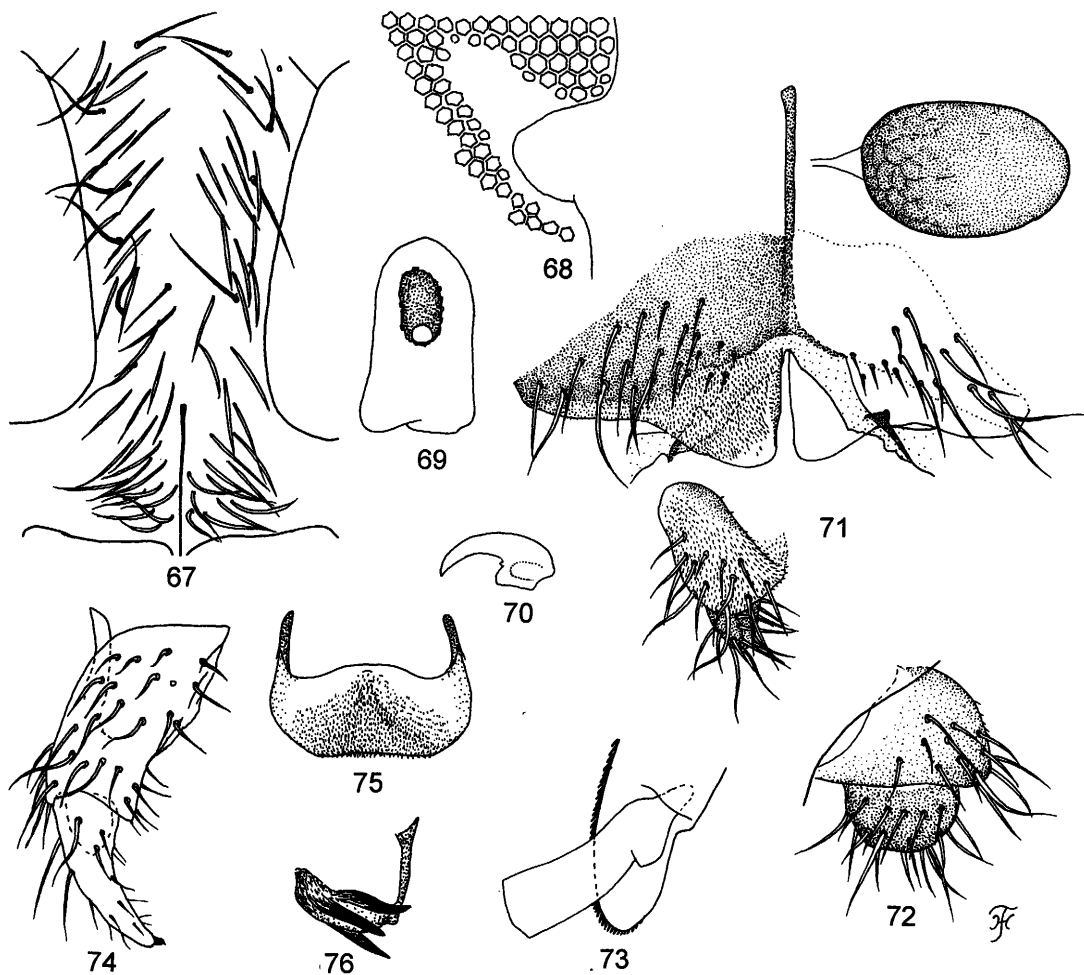
**REMARKS.** This species is characterized in the male by the presence of the parameral hooks and in the pupa by the simple, wall-pocket-shaped cocoon and the six slender gill filaments, of which dorsal four filaments are much slender and shorter than the ventral paired filaments, as described by Stone and Maffi (1971). It is noticeable that the female genitalia are very similar to that of *S. (G.) hiroshii*, described from the Solomon Islands (Takaoka, 1994), especially in the genital fork with a projection directed anteriorly on each arm, and the spermatheca with internal setae. Takaoka (1983) noted that eight *Morops* species found in the Philippines have more similarities to *S. (M.) sherwoodi* than all the other *Morops* species reported from Papua New Guinea and Australia in having the parameral hooks in the male genitalia, and 6-filamented gill in the pupa. It is now clear that *S. (M.) sherwoodi* and all the Philippine *Morops* species are very similar in the male and mature larva, but the former species is readily separated from the latter in the female by the almost bare frons, tarsal claws with a minute tooth, and the spermatheca with internal setae, and in the pupa by the frontal integument with two pairs of trichomes, the absence of grapnel-like hooklets and plate-like, terminal hooks.

#### 8. *Simulium (Morops) noroense* sp. nov.

**DESCRIPTION. Female.** Body length ca. 2.2 mm. *Head.* Slightly narrower than thorax. Frons (Fig. 67) dark brown, whitish grey pruinose, shiny in certain angles of light, moderately covered with yellowish white, scale-like, recumbent pubescence, interspersed with a few dark hairs along both lateral margins; frontal ratio 1.7:1.0:2.6. Frons-head ratio 1.0:5.3. Fronto-ocular area (Fig. 68) well developed. Clypeus dark brown, densely covered with yellowish white, scale-like, recumbent pubescence, interspersed with several dark hairs. Antenna composed of 2+9 segments, brownish black except scape, pedicel and base of 1st flagellar segment yellowish. Maxillary palp with 5 segments; proportional lengths of 3rd, 4th and 5th segments 1.0:1.3:2.7; 3rd segment somewhat enlarged, sensory vesicle (Fig. 69) elongate,  $1.9 \times$  as long as wide,  $0.4 \times$  as long as 3rd segment, with a large opening near distal end. Maxillary lacinia with 9 inner and 11 or 12 outer teeth. Mandible with ca. 21 small inner teeth and lacking outer ones. Cibarium smooth. *Thorax.* Scutum blackish brown in ground color, whitish grey pruinose, densely covered with whitish yellow, recumbent pubescence except median large area with dark brown pubescence; 3 longitudinal vittae of whitish yellow, recumbent pubes-

cence (1 median vitta very narrow and 2 submedian ones rather wide), which are connected anteriorly and posteriorly to areas of the concolored pubescence. Scutellum blackish brown with brown pubescence and long, erect, dark hairs along posterior margin. Postscutellum blackish brown, whitish grey pruinose (shining in light), bare. Pleural membrane with ca. 25 yellowish white pubescence. Katepisternum longer than deep, dark brown, whitish grey pruinose (shining in light), with numerous dark hairs; sulcus distinct. *Legs*. Foreleg: coxa and trochanter yellow; femur brown; tibia white with distal 1/4 brownish black, outer surface widely white shining when illuminated; tarsus black; basitarsus dilated, ca.  $4.6 \times$  as long as its greatest width. Midleg: coxa dark brown; trochanter yellow; femur brown with apical cap dark

brown; tibia white on basal 1/3, brownish black on rest, though its border not well defined; posterior surface of tibia widely white shining when illuminated; tarsus black. Hind leg: coxa yellowish brown; trochanter yellowish white; femur brown with apical cap dark brown; tibia white on basal 2/3, brown to brownish black on rest, though its border not well defined; posterior surface of tibia widely white shining when illuminated; tarsus brown with basal 3/5 of basitarsus and basal 1/2 of 2nd tarsomere white; basitarsus slender, parallel-sided, ca.  $6.6 \times$  as long as wide. Calcipala well developed, ca.  $1.3 \times$  as long as wide. Pedisulcus well developed. Hind femur and tibia  $2.4 \times$  and  $1.9 \times$  as wide as hind basitarsus, respectively. All femora and tibiae densely covered with scale-like hairs on outer surface.



Figs. 67-76. Adult characters of *Simulium (Morops) noroense* sp. nov. 67, frons; 68, fronto-ocular area; 69, 3rd maxillary palpal segment; 70, claw with a minute tooth; 71, genitalia in situ (ventral view); 72, paraproc and cercus (side view); 73, calcipala and pedisulcus; 74, coxite and style (ventral view); 75, ventral plate (ventral view); 76, paramere (ventral view). 67-72, ♀; 73-76, ♂.

Claws (Fig. 70) each with a rudimentary, minute basal tooth. *Wing*. Length 1.5 mm. Costa with spinules as well as hairs. Subcosta haired. Hair tuft on stem vein dark brown. Basal portion of radius fully haired. *Abdomen*. Basal scale brown with fringe of yellowish white hairs. Dorsal surface of abdomen black, with dark hairs; tergite of 2nd segment whitish pruinose, tergites of segments 5-8 shiny. *Genitalia* (Figs. 71 & 72). Sternal plate undeveloped on abdominal segment 7. Sternite 8 bare medially, with 15-18 dark macrosetae on each side. Anterior gonapophysis triangular, thin, membranous, covered densely with microsetae interspersed with a few setae; inner margin well sclerotized. Genital fork of usual inverted-Y form, with arms rather broad, folded medially, each with a distinct projection directed forward. Paraproct of usual form. Cercus  $0.56 \times$  as long as wide, with posterior border gently rounded when viewed laterally. Spermatheca ellipsoidal, well sclerotized except tube and tubal base unsclerotized; internal setae present.

**Male**. Body length ca. 2.5 mm. *Head*. Wider than thorax. Upper eye consisting of 9 or 10 vertical columns and 11 horizontal rows of large facets. Clypeus brownish black, whitish pruinose, covered densely with yellow pubescence, interspersed with several dark hairs. Antenna composed of 2+9 segments, yellow with 4 or 5 apical segments brown; 1st flagellomere somewhat elongate, ca.  $1.5 \times$  as long as 2nd one. Maxillary palp with 5 segments; proportional lengths of 3rd, 4th and 5th segments 1.0:1.2:3.0; sensory vesicle oblong,  $0.27 \times$  as long as 3rd segment, with opening somewhat distally (or near distal end). *Thorax*. As in ♀ except pleural membrane with ca. 20 yellow pubescences. *Legs*. Foreleg: coxa and trochanter whitish; femur brown; tibia yellow (though appearing brown due to dense covering of dark pubescence) with distal 1/3 dark brown, silvery shining in light largely on outer surface; tarsus brownish black; basitarsus somewhat dilated, ca.  $5.5 \times$  as long as its greatest width. Midleg: dark brown to brownish black except trochanter and base of tibia yellow. Hind leg: coxa brown; trochanter yellow; femur dark brown; tibia white on basal 1/2, brownish black on distal 1/2; tarsus brownish black except basal 3/5 of basitarsus and basal 1/2 of 2nd tarsomere white; basitarsus slender, almost parallel-sided, ca.  $5.3 \times$  as long as wide. Hind femur and tibia ca.  $1.8 \times$  and  $1.6 \times$  width of hind basitarsus, respectively. Calcipala (Fig. 73) well developed,  $1.45 \times$  as long as wide. Pedisulcus (Fig. 73) well developed. All femora and tibiae densely covered with scale-like hairs on outer surface. *Wing*. Length 1.5 mm. Other features as in ♀ except subcosta bare.

*Abdomen*. Basal scale yellow, with fringe of yellow hairs. Dorsal surface of abdominal segments brownish black, covered with dark hairs; segments 2, 5-7 each with a dorsolateral pair of shiny, whitish pruinose patches; those on segment 2 widely connected in middle. *Genitalia*. Nearly as in *S. (M.) sherwoodi* except ventral plate. Ventral plate (Fig. 75) transverse,  $0.45 \times$  as long as wide, not markedly angulate on both lateral margins. **Pupa**. As in *S. (M.) sherwoodi* except following features: *Head*. Integument yellow. *Thorax*. Integument yellow, moderately covered with round tubercles except posterodorsal surface with small, cone-shaped ones. *Abdomen*. Terga 1 and 2 almost transparent. Tergum 6 with no or a few spine-combs.

**Mature larva**. As in *S. (M.) sherwoodi* except following features: Body length 3.8-4.0 mm. Body uniformly greyish. Labral fan with ca. 34 main rays. Rectal papilla compound, each of 3 lobes with 2 or 3 finger-like, secondary lobules on posterior surface.

**TYPE SPECIMENS**. Holotype ♀, reared from pupa, slide-mounted together with pupal exuvia and cocoon, collected from a stream, Noro, New Georgia Island, Western Province, Solomon Islands, 5. IX. 1992, by H. Suzuki. Allotype ♂, reared from pupa, slide-mounted, same data as holotype. Paratypes: 1 ♀, 3 ♂, all reared from pupa, 2 pupae and 3 mature larvae, all in alcohol, same data as holotype; 2 ♀, 2 ♂, all reared from pupa, 15 pupae, 1 pupal exuvia and 25 mature larvae, in alcohol, same data as holotype except date: 21. II. 1993.

**DISTRIBUTION**. Solomon Islands (New Georgia Island).

**REMARKS**. This species is very similar to *S. (M.) sherwoodi* in many features including the genitalia of both sexes and the pupal gill filaments. However, *S. (M.) noroense* differs from the latter species by the dark coloration of the femora of both adult sexes, female frons furnished with scale-like pubescence (Fig. 67), male ventral plate not markedly angulate laterally (Fig. 75), and pupal thorax moderately covered with tubercles. The tarsal claw of the female *S. (M.) noroense* has a minute basal tooth (Fig. 70), which is much smaller than that of *S. (M.) sherwoodi* (Fig. 53).

### 9. *Simulium (Morops) kerei* Takaoka and Suzuki, 1994

*Simulium (Morops) kerei* Takaoka and Suzuki, 1994: 207-210.

This species was recently described based on adult male and pupal specimens collected from New Georgia Island, Solomon Islands (Takaoka and Suzuki, 1994). The mature larva is here described.

**DESCRIPTION. Mature larva.** Body length ca. 5.0 mm. Body greyish black. Cephalic apotome pale yellow with distinct, positive head spots. Antenna with 3 segments and apical sensillum, longer than stem of labral fan; proportional lengths of 3 segments from base to tip 1.00:0.96:0.81. Labral fan with ca. 45 main rays. Mandible as in *S. (M.) sherwoodi*. Hypostomium (Fig. 65) with a row of 9 apical teeth, of which median tooth is subequal in size to each corner tooth; 6 intermediate teeth different in length and much shorter than corner teeth; lateral margin not serrate; hypostomal bristles 7 or 8 in number per side lying subparallel to lateral margin. Postgenal cleft (Fig. 66) nearly triangular, gradually narrowed anteriorly, ca. 4.0 × as long as postgenal bridge. Thoracic cuticle bare. Abdominal cuticle bare except each side of anal sclerite of last segment moderately covered with numerous colorless setae. Rectal papilla compound, each of 3 lobes with 2 or 3 finger-like, secondary lobules on posterior surface. Anal sclerite of usual X-form, with anterior arms ca. 0.9 × as long as posterior ones, broadly sclerotized at base. Ventral papillae present. Posterior circlet with ca. 100 rows of up to 18 hooklets per row.

**SPECIMENS EXAMINED.** 5 pupal exuviae and 2 mature larvae, Noro, New Georgia Island, Western Province, Solomon Islands, 21. II. 1993, by H. Suzuki.

**DISTRIBUTION.** Solomon Islands (New Georgia Island).

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