# PAPUAN WEEVIL GENUS GYMNOPHOLUS: SECOND SUPPLEMENT WITH STUDIES IN EPIZOIC SYMBIOSIS<sup>1</sup>

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Abstract: Six more new species of Gymnopholus are described: pulcher, biformis, tricolor, shungolus, schefflerae and colmani. The 3 latter species have plant growth on them, and the last 2 have phytophagous mites as well. A marked individual of G. lichenifer Gress., released on summit of Mt Kaindi, has now been observed for 3 years. Since plant growth was already advanced on original marking, age of the weevils must be about 5 years. A trombidiform mite was observed actively searching on a G. lichenifer bearing extensive plant growth.

The genus *Gymnopholus*, a member of the weevil subfamily Leptopiinae, is of considerable interest because many of the species support gardens on their backs, and also often on their legs. This association living on the flightless weevils includes members of at least 14 families of algae, fungi, lichens, hepatics and mosses. Among these plants live protozoans, rotifers, nematodes, and phytophagous oribatid mites as well as occasional psocopterans.<sup>3</sup> In April 1970 a small trombidiform mite (Prostigmata) was observed actively running around searching among plants growing on an individual of *G. lichenifer* Gress. on the summit of Mt Kaindi, NE New Guinea.

Since 1966 experiments have been carried out on Mt Kaindi to attempt to learn the adult life-span of these weevils, rates of plant growth, arrival of animal associates and other aspects of the relationship. Because of some additional clearing at the summit of the mountain, there was some loss of habitat and greater disappearance of marked individuals. Information on marking techniques, and some data on behavior is included in the 2 short notes following this one.

A large cage (cubic, 2.7 meters per side) was erected on the summit of Mt Kaindi on 17 July 1969. The cage is set slightly into the ground, with ground for floor, and contains several young trees of *Eurya* and *Evodia*, the preferred food plants of *Gymnopholus lichenifer*. Field collections of weevils from Mt Kaindi and from the Bulldog Road to the south were made and 33 marked individuals were released in the cage during July and August 1969. These were all *G. lichenifer* except for a single pair of *G. acarifer* from Bulldog Road. Of the former, 3 (old #50, #75, #90) had been marked in 1967 (April and May), so that 3 years had elapsed since their original marking. As all 3 had well developed gardens at that time, they are now obviously much more than

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3 years old and more likely 4 or 5 years old. After the cage had been in operation for some months, evidence was obtained to substantiate a supposition made on the basis of many specimens collected earlier. This is that frequently with old individuals the plant growth may fall off the weevils as a result of erosion of various sorts such as in mating, fighting, falling off plants or other events. Some individuals which had been marked and recorded with advanced plant growth were later found without any, resembling many collected specimens. These individuals had few or no dorsal scales remaining, giving the distinctly eroded appearance which can now definitely be associated with old individuals which have lost extensive plant growth and the associated animals. The specialized scales, many of which have erect processes resembling setae, are the main media of attachment of the plants, besides the fact that the usual pits or depressions provide protected sites and additional means of attachment. It was earlier pointed out that the plants make their start where there are hairs or specialized scales and it is obvious that the plants are attached to these structures. It also appears that the hairs and scales have been modified to encourage plant growth. Species of Gymnopholus which do not have the plant association have normal flat scales or smooth glabrous body surfaces.

Other kinds of information on this association have been obtained through the system of marking, release and occasional censuses. Some of this will be reported later, but a point of interest relates to movement of individuals. In spite of the fact that these weevils are fairly sedentary, as indicated in Dr Szent-Ivany's note below, they at times do considerable walking. In some earlier observations 3 individuals covered about 0.25 km within half an hour, before being lost. One individual (#143) which was marked and released on the south summit of Mt Kaindi on 26.V.1967 was recovered 7.V.1968 at 0.75 km airline away, but probably more than 1 km by the route the weevil might have taken. This was over the second hump on the trail along the power-line to Edie Creek. If the vegetation around the summit were not so dense, and if there were more trails, no doubt many more recoveries of marked weevils would have been made.

#### **SYSTEMATICS**

In the following treatment, 6 new species are described. These are assigned numbers within the series of the original enumeration by Gressitt in 1966. To put these in proper perspective, all the names are listed below by species-groups. One change is that #2, *articivorax*, is shifted from the Nothofagi-group to the Fulvospretus-group. In the following list, H. stands for Heller, M. for Marshall, G. for Gressitt and S. for Sedlacek. Asterisk indicates new species in this paper.

List of species of Gymnopholus Heller, 1901, by species-groups Subgenus Gymnopholus s. str.

Nothofagi: 1. nothofagi G. — la. ellynae G. & S. — lb. toxopei G. & S. — lc. setosus G. & S. — ld. subnacreus G. & S. — le. rostralis G. & S.

Marquardti : 3. marquardti H. - 4. mammifer G. - 4a. pulcher\* - 5. muscosus G. - 5a. vetustus G. & S. - 6. gressitti M. - 7. ajax G. - 8. splendidus G. - 9. gemmifer G. - 10. carinatus H. - 11. angustus M. - 12. perspicax G.

- Fulvospretus: 13. fulvospretus (H.) 14. cyphothorax (H.) 14a. biformis\* 14b. tricolor\* 15. marshalli G. 16. suturalis (H.).
- Interpres: 17. interpres H. 18. brandti G. 19. divaricatus G. 20. glochidionis G. 21. integrirostris (H.) 22. ludificator G.
- Weiskei: 23. weiskei H. -24. regalis G. -25. sedlaceki G.
- Magister: 26. magister G. 27. hornabrooki G. – 28. szentivanyi G.
- Seriatus: 28a. seriatus G. & S.

Subgenus Symbiopholus G.

- Audax : 29. audax G. 29a. nitidus G. & S. 30. praecox G.
- Fallax: 44. fallax G.
- Kokodae: 31. kokodae M.
- Cheesmanae : 32. cheesmanae M. 33. algifer G. — 33a. rebeccae G. & S. — 33b. shungolus\* — 34. symbioticus G. — 35. zoarkes G.
- Reticulatus : 36. reticulatus M. 37. botanicus G. — 38. vegetatus G. — 38a. carolynae G. & S. — 39. rugicollis (H.)— 39a. schuurmansiae G. & S. — 40. fungifer G. — 41. lichenifer G. — 45. h. herbarius G. — 45a. h. oribatifer G.



Fig. 1. Gymnopholus (s. str.) pulcher Gressitt & Sedlacek, n. sp., holotype 3.

Acarifer : 42. acarifer G. — 43. senex G. — 46. hepaticus G. — 47. schefflerae\* — 48. colmani\*

> Subgenus Gymnopholus s. str. Marquardti-group

# 4. Gymnopholus (Gymnopholus) mammifer Gressitt (1966:235) Fig. 2a, 3a, 4a.

A series of  $4 \partial \partial$  and  $1 \varphi$  was taken by Gressitt & P. Colman on Mt Shungol, the type locality, between 2000 and 2700 m, 31.V.1967, partly on *Schefflera*. The basal elytral spot of  $\partial$  varies considerably in size and in color from pale tawny to pinkish ochreous.

The  $\varphi$  of this species was not seen earlier. It is remarkably similar to  $\varphi$  of *marquardti* except that the pronotum has a pair of prominent tubercles on the top of the disc. In *marquardti* the  $\varphi$  pronotum has only a pair of feeble swellings.

The paratype & designated from Bome, Goilala is most likely a different species.

#### Marquardti-group

# 4a. Gymnopholus (Gymnopholus) pulcher Gressitt and Sedlacek, new species Fig. 1, 2b, 3b, 4b.

 $\Im$ . Shiny black, in part clothed with dense pale nacreous green or ochreous pubescence; head with a few scattered pale green to whitish hairs beneath; antenna with sparse oblique whitish to pale tawny hairs, reduced to minute ones on club; prothorax with a few whitish green scale-hairs along parts of median groove and similar greenish to bluish ones beneath; scutellum with close smaller pale green scale-hairs; elytron with a large rounded triangular postbasal depressed area of subnacreous whitish to greenish scale-hairs, a narrower band of the same just behind middle and on side 2 areas similar and adjacent to above except of golden ochreous scales bordered by silvery green ones, besides a number of small bluish green spots, mostly on apical declivity and along outer margin; ventral surfaces with scattered greenish hairs or scale-hairs on thorax and lateral border of abdomen, with longer oblique pale hairs on abdominal sternites; legs with irregular greenish to pale hairs, denser and greener on upper portions of femora.

Head moderately even, with fine shallow punctures and a median shallow groove on rostrum. Antenna slender; scape reaching hind edge of eye; funicle segments gradually decreasing in length; club slender-elliptical. Prothorax gradually tapering from base to apex, nearly as long as breadth at base, fairly smooth, feebly punctured, grooved medially and bearing a prominent rounded tubercle on each side of center. Scutellum small, widest in middle. Elytron narrow, subparallel-sided in basal 2/3, narrowed apically, depressed in dorsal scaled areas, sparsely and feebly punctured, with a prominent postmedian sublateral tubercle, about  $2 \times$  as high as pronotal tubercle. Ventral surfaces fine, sparsely and irregularly punctured. Legs slender, sparsely to moderately punctured. Length of thorax and elytron 15.4 mm; length of head 7.5; breadth 6.9.

Holotype ♂ (BISHOP 9279), North slope, Mt Strong, 2600-3000 m, Owen Stanley Mts, SE New Guinea, 8-10,I.1968, J. H. Sedlacek; paratype ♂, same data. A questionable ♀ is from Arabuka, Morobe Distr., NE New Guinea, 1500-2000 m, 7,I.1968, J. H. Sedlacek.

Differs from *mammifer* Gress. in being more slender, with pale green instead of yellowish pubescence and with a distinct dorsal postmedian band and with pronotal tubercle less prominent and with elytral tubercle weaker and more tapered apically.

### Fulvospretus-group

Originally G. urticivorax Gress. was described as a member of the nothofagi-group. However, the former does have appreciable pronotal tubercles and otherwise differs from nothofagi. Although the depressed markings of urticivorax are very characteristic, that species is very close in other respects to fulvospretus Hllr, particularly in the genitalia. The other new species described below for this group (biformis, tricolor) conform to the latter pattern.

#### 14. Gymnopholus (Gymnopholus) cyphothorax (Heller), 1901

A long series was taken on Mt St. Mary, 1900 m, Owen Stanley Mts, SE New Guinea, 8-21.VII.1968, by Abid Beg Mirza.

#### 14a. Gymnopholus (s. str.) biformis Gressitt and Sedlacek, new species Fig. 2c, 3c, 4c.

 $\Im$ . Black; elytra shiny black. Head sparsely clothed with pale hair. Antenna densely clothed with strong pale hair, very short on club; pronotum with very sparse minute hair, elytron same as pronotum but with a narrow sutural stripe of more dense short hair and scattered blue and pale scales; blue scales become dense in apical declivity; thoracic sternites clothed densely, center of abdominal sternites at base sparsely with pale hair; legs moderately clothed with pale hair and more sparsely with blue scales.

*Head*: densely and finely punctured, rostrum shallowly grooved on top with side grooves even less distinct; rostrum punctured more coarsely and deeply than head at base. *Antenna* slender and long, last segment of funicle reaching base of pronotum; scape as long as first 4 segments of funicle combined, slender, swollen at apex; funicle with segment 2 slightly longer than 1, which is distinctly longer than 3; club slender. *Prothorax* longer than broad, sinuate at side, tubercles moderately high, separated by distinct groove transformed into broad and deep depression anteriorly, almost touching the anterior rim of pronotum; surface densely punctured with irregular vertical wrinkles at side. *Scutellum* almost round, narrowed at base, finely punctured and with pale hair on the rim. *Elytron* slightly widened at middle with weak tubercles near apex, finely punctured with punctures arranged in 9 rows; suture moderately raised a short distance before apex. *Ventral surfaces* finely punctured. *Legs* asperate punctate. Length 16 mm (19 including rostrum). Breadth 6 mm.

 $\varphi$ . Broader with sharper and stronger ridges on elytron, less shiny and smooth and with few scattered golden-green scales on side rim of elytron. This species has 2 forms in female; the rarer form has a median portion of elytron with a distinct groove filled with golden-green scales very densely. The groove may be interrupted in middle or branch in two towards apex; in some specimens there is a similar but much smaller groove below front side ridge filled with golden-green scales. Length 22 mm (25.5 with rostrum); breadth 8 mm.

Holotype ♂ (BISHOP 9280), Arabuka, 1800 m, 22 km S of Garaina, NE New Guinea, 7. I. 1968, J. & M. & J. H. Sedlacek; allotype ♀ (BISHOP) same data; 9 paratypes same data; 21 paratypes: Moima, 30 km S. Garaina, 2000 m, 7.I.1968, J. &. M. & J. H. Sedlacek; 5 paratypes: N. slopes of Mt Strong, 2650 m, NE New Guinea, 8-10.I.1968, J. & M. & J. H. Sedlacek.

Length of paratypes 15.5 mm (18.5) - 22 (25.5 including rostrum).

Second form of female differs from female *urticivorax* in being more slender, with elytral stripes not reaching tubercles and having more blue scales at apex.

# 14b. Gymnopholus (s. str.) tricolor Gressitt and Sedlacek, new species Fig. 2e, 3d, 4d.

 $\mathfrak{F}$ . Black ; head sparsely clothed with pale hair, short on club, pronotum with very sparse minute hair, elytron with sparse pale hair along the suture and minute blue scales on the suture. Median portion of elytron with 2 distinct grooves, completely filled with golden-green scales. More of pale and greenish hair near apex which is also partly clothed with blue and very pale green scales ; apical declivity clothed more densely with blue scales and scattered oblique pale hair. Ventral surfaces with scattered pale hairs more dense in central part of sternites, thoracic sternites also with patches of blue scales.

*Head*: Lightly punctured on the base, rostrum with very shallow broad upper groove and shallow side grooves, rough and deeply punctured. Upper groove slightly broadens between eyes where it has a deep puncture in center. *Antenna* long, scape reaching beyond the center

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Epizoic symbiosis



Fig. 3. Dorsal outline of pronotum viewed from behind: a, Gymnopholus mammifer G.; b, G. pulcher n. sp; c, G. biformis n. sp; d, G. tricolor n. sp.; e, G. shungolus n. sp.; f, G. vegetatus G.,  $\mathcal{F}$ , Mt Michael; g, G. schefflerae n. sp.; h, G. colmani n. sp.

of the eye, last segment of funicle reaching base of elytron. Scape slightly longer than 3 first segments of funicle combined; segment 2 of funicle distinctly longer than segment 3 which is slightly shorter than segment 1. *Prothorax* longer than broad, finely punctured, sinuate at sides; tubercles moderately high, separated by deep groove with broad depression, anterior tubercles narrowing sharply before reaching anterior rim of pronotum. *Scutellum* round, distinctly punctured with sparse bluish and pale green hair along the rim. *Elytron* slightly widened before the middle, tubercles weak; minute punctures are arranged in 9 rows; sides slightly wrinkled. Suture raised a short distance before apex. *Ventral surfaces* finely and almost evenly punctured. Legs asperate. Length 17 mm (20 with rostrum), breadth 6 mm.

Holotype & (BISHOP 9281), Mt St. Mary, 2500 m, Papua, VII.1968, Abid Beg Mirza.

Differs from *biformis* in having in  $\mathcal{J}$  elytral grooves filled with golden-green scales, from *urticivorax* in having elytral grooves in median portion of elytron not connected.

# Cheesmanae-group

# 33b. Gymnopholus (Symbiopholus) shungolus Gressitt & Sedlacek, new species Fig. 2f, 3e.

 $\mathfrak{F}$ . Black, slightly shiny above, quite shiny beneath. Dorsum nearly glabrous, a very few short pale hairs in pronotal groove and in the very few elytral depressions; antennal funicle with a very few oblique pale hairs; legs with many stout oblique tawny hairs; ventral surfaces nearly glabrous.

Head about as broad anteriorly as at eyes, broader behind, deeply grooved medially, shallowly and broadly grooved beneath, minutely punctured above, coarsely rugose-punctate at side. Antenna with scape not quite reaching hind edge of eye, 2nd funicle segment  $2 \times as$  long as last,

Fig. 2. a, Gymnopholus (s. str.) mammifer Gress.,  $\mathfrak{P}$ ; b, G. (s. str.) pulcher G. & S., n. sp., paratype  $\mathfrak{F}$ ; c, G. (s. str.) biformis G. & S., n. sp., holotype  $\mathfrak{F}$ ; d, same, allotype  $\mathfrak{P}$ ; e, G. (s. str.) tricolor G. & S., n. sp., holotype  $\mathfrak{F}$ ; f, G. (Symbiopholus) shungolus G. & S., n. sp., allotype  $\mathfrak{P}$ ; g, G. (S.) schefflerae G. & S., n. sp., holotype  $\mathfrak{F}$ ; h, same, paratype  $\mathfrak{F}$ ; i, G. (S.) colmani G. & S., n. sp., holotype  $\mathfrak{F}$ .

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and club fairly short and stout. *Prothorax* large, slightly longer than broad, nearly as wide as elytra, subparallel-sided but constricted anteriorly; side feebly convex and feebly wrinkled in an oblique manner; disc strongly raised, with a pair of very large subevenly rounded smooth tubercles with a groove between, which is deeper anteriorly; tubercles sloping evenly to base but steeply declivitous anteriorly, their highest point much nearer apex than base. *Scutellum* depressed, slightly broadened preapically, minutely punctured. *Eltyron* subparallel-sided in basal 1/3, then gradually narrowed to just before apex where there is a weak rounded swelling, leaving apex rounded-obtuse; basal margin slightly raised; humerus subrounded; disc with a few incomplete rows of shallow punctures, a humeral ridge somewhat corrugated, postmedian portion largely smooth, with a very small postmedian tubercle not affecting lateral outline and followed by a slight depression preceding preapical sublateral swelling, which has a few weak depressions around it. *Ventral surfaces* smooth, nearly impunctate. *Legs* only moderately stout; femora wrinkled, with tubercles above; tibiae tuberculate apically. Length of thorax and elytron 23.6 mm; length of head 11; breadth 8.3.



Fig. 4. Aedeagi, side and dorsal views: a, *Gymnopholus mammifer* G.; b, G. *pulcher* n. sp.; c, G. *biformis* n. sp.; d, G. *tricolor* n. sp.; e, G. *schefflerae* n. sp.; g, G. colmani n. sp.

 $\varphi$ . Very similar to  $\Im$ ; elytral punctures fine, in fine grooves, continuing to behind middle. Length of thorax and elytron 26; length of head 8.5: breadth 9.6.

Paratype Q. Length of thorax and elytron 25 mm; length of head 9; breadth 9.2.

Holotype  $\mathcal{J}$  (BISHOP 9282), Mt Shungol, 2700 m, near Lae, NE New Guinea, 31.V. 1967, Gressitt & P. Colman; allotopotype  $\mathcal{Q}$  (BISHOP), same data, but on host BMF-137; paratopotype  $\mathcal{Q}$ , BMF 136. Plant growth apparently starts early on the rough hairy legs. The holotype has growth on femora, but little on elytra.

Differs from *rebeccae* Gress. & Sedl. in being narrower, more glabrous above, with pronotal tubercles larger, more evenly rounded, more vertical at side and more declivous anteriorly, with elytron less convex, narrowed from farther forward and less tuberculate.

# 47. Gymnopholus (Symbiopholus) schefflerae Gressitt and Sedlacek, new species Fig. 2g, 3g, 4e.

 $\mathcal{S}$ . Black. Depressions of dorsum with greenish to reddish modified scales bearing fine erect hair-like processes; ventral surfaces and legs with sparse oblique pale hairs.

*Head* stout, wider posteriorly than at eyes, about as wide near apex as at eyes, moderately grooved medially above, deeply grooved medially beneath and with 3 distinct grooves at side, in large part minutely punctured. Antenna with scape distinctly thickened apically, extending slightly beyond eye; 1st 2 segments of funicle distinctly longer than others, which are progressively shorter; club subfusiform. Prothorax stout, distinctly wider than long, much wider at base than at apex, strongly convex at side and widest near middle; disc depressed medially, strongly raised on each side, with a somewhat uneven ridge above, at side, not extending as far out as middle of side; surface coarsely rugose to vermiculose, with deep depressions. Scutellum small, widest at middle, somewhat raised. Elytron stout, roughly parallel-sided in basal 1/2, narrowed and broadly rounded behind, somewhat ridged on basal margin; humeral angle subacutely projecting outward; disc with irregular subrounded deep pits of different sizes, with a blunt sublateral tubercle at base of last 1/4 followed by a depression and then a raised area on declivity with a depression above (toward suture) and below it. Ventral surfaces in large part smooth, somewhat shiny, with almost no punctures. Legs stout, feebly punctured; tibiae finely denticulate internally. Length of thorax and elytron 25 mm; length of head 10.5; breadth 9.4.

 $\varphi$ . Body quite stout; green scales of dorsum fairly extensive in area covered, interspersed with erect spindle-like processes. Pronotum more nearly horizontal (except for median groove) in hind view. Length of thorax and elytron 28 mm; length of head 11; breadth 11.7.

Paratypes: Length of thorax and elytron 24-29; breadth 9-12.5.

Holotype  $\mathcal{J}$  (BISHOP 9283), Mt Shungol, 2700 m, near Lae, NE New Guinea, 31.V.1967, Gressitt & P. Colman; allotopotype  $\mathcal{Q}$  (BISHOP), same data; 7 paratopotypes, same data, partly on *Schefflera*. Holotype with extensive red fungi; allotype and 1 paratype with no plants; others with extensive fungal/algal growth, partly lichenized.

Differs from *acarifer* in being a little less stout in  $\varphi$  with pronotum wider at middle of side than at top of dorsal ridges and depression between more biconvex, and median elytral ridge less prominent and elytral pits less regular.

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### Gymnopholus (Symbiopholus) colmani Gressitt and Sedlacek, new species Fig. 2i, 3h, 4g.

 $\mathfrak{F}$ . Black. Depressions of dorsum with complex golden green scales with erect processes; antenna with sparse oblique pale hairs; ventral surfaces with only a few fine oblique pale hairs; legs with denser stout tawny hairs.

Head stout, slightly broader at apex and base than at eyes, nearly flat medially above, minutely punctured, finely grooved above and beneath antennal groove. Antenna with scape not quite reaching hind border of eye, moderately thickened apically, 2nd funicle segment much longer than last; club subfusiform. Prothorax slightly broader than long, distinctly narrower at apex than at base, strongly rugose to subvermiculose, slightly grooved medially, with a strong, sharp, arched ridge at top of swelling at each side of disc, nearly as far apart as widest portion at sides. Scutellum raised, glabrous, somewhat shiny, broadly rounded behind. Elytron moderately stout, widest a little behind humerus, gradually narrowed posteriorly, narrowed behind postmedian tubercle, then less narrowed for a short distance, then subobtuse apically; disc with uneven series of deep depressions, with a slightly raised area just behind center; a deep broad depression behind moderately prominent postmedian tubercle, then a raised area at suture on apical declivity, with slightly depressed areas above, beneath and at each side, and additional depressions on and beneath a sublateral raised area on side of declivity. Ventral surfaces largely smooth, somewhat shiny, feebly punctured. Legs fairly stout, moderately punctured, wrinkled; tibiae with prominent denticles interiorly. Length of thorax and elytron 24 mm; length of head 10.5; breadth 9.

 $\varphi$ . Similar to  $\Im$  but stouter. Length of thorax and elytron 27 mm; length of head 11; breadth 12.9. Paratype  $\varphi$  approximately same dimensions.

Holotype  $\mathcal{F}$  (BISHOP 9284), Mt Shungol, 2400 m, near Lae, NE New Guinea, on *Schuurmansia*, 31.V.1967, Gressitt; allotopotype  $\mathcal{P}$  (BISHOP), 2700 m, BMF-130, 31.V.1967, Gressitt & P. Colman; 2 paratopotypes,  $\mathcal{F}$ ,  $\mathcal{P}$ , 2600-2700 m, 31.V.1967, Gressitt & Colman. All specimens with extensive fungal/algal growth, with some lichen growth and a few hepatics.

Differs from *acarifer* in being less stout, in having distinct sharp ridges on tops of pronotal tubercles, biconcave instead of biconvex on inner sides of same, less distinct elytral ridges and less regular elytral pits, with more prominent postmedian tubercle. Differs from *schefflerae* in largely the same characters and in having aedeagus deeply grooved for most of its length. This species is named for Philip Colman of the Australian Museum, Sydney, who jointly collected this species and others with Gressitt while assistant at Bishop Museum Field Station, Wau, New Guinea.