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INSECTS OF CAMPBELL ISLAND. APPENDIX. LEPIDOPTERA: GEOMETRIDAE

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Abstract: Six species of Geometridae, all in the subfamily Larentiinae, occur on Campbell I. *Xanthorrhoe campbellensis* n. sp. (*X. oxyptera* part) and *Chloroclystis impudicis* n. sp. are endemic and may represent the survivors of the earliest invasion of this island by moths. *Xanthorrhoe orophylloides* Hudson (=*X. subantarctica* Salmon) is common to Campbell and Auckland Is. *Hydriomena similata* Walker, *Epiphryne charidema* Meyrick and *Chloroclystis* sp. near *suffusa* Hudson are present also on Auckland Is. and in the South and North Islands. Genitalia are figured and described. Where possible larvae have been assigned to species, and a key to larvae is given. *Epiphryne* Meyrick (1884) is resurrected for *charidema* and allies, the palaearctic *Venusia* Curtiss being unsuitable.

This paper deals with some 200 adult and larval Geometridae collected during the 1961–63 Bishop Museum collecting program on Campbell I. Material from the Cape Expedition (Salmon 1956) and from the 1907 expedition (Hudson & Meyrick 1909) was also examined. This review is hampered in that the mainland fauna is still imperfectly known, but it has been possible to make some generalizations. No serious attempt has been made to revise the larentiine Geometridae, with 202 described species, since Meyrick (1917) laid down his classification. Prout (1927) modified slight points, but nothing else has been done apart from unpublished reshufflings in the British Museum collections (D. S. Fletcher, pers. comm.) and additions of new species. For the purposes of this paper, no changes are made in the use of the Palaearctic genera *Hydriomena* Hübner, *Chloroclystis* Hüb., and *Xanthorrhoe* Hüb., although *Epiphryne* Meyrick is resurrected to replace the unsuitable *Venusia* Curtiss, for the New Zealand species. Fletcher (pers. comm.) has expressed doubts about the generic placing of *H. similata*, but the study is incomplete.

The Campbell I. geometrid fauna comprises the following six species, with their broad distributions given in parentheses: *Hydriomena similata* Walker (Campbell, Auckland, Stewart, South, North Is.); *Epiphryne charidema* Meyrick (Campbell, Auckland, South Is.); *Xanthorrhoe orophylloides* Hudson (Campbell, Auckland Is.); *Xanthorrhoe campbellensis* n. sp. (Campbell I.); *Chloroclystis impudicis* n. sp. (Campbell I.); *C.* sp. nr. *suffusa* Hudson (Campbell, Auckland, South, North Is.)

The fauna is curiously incomplete. The only species with possible close connections with the very distinctive alpine fauna of the main islands could as easily have been derived from a lowland species. Otherwise there are no alpine representatives, although the flora and climate on Campbell suggest that conditions for such species exist. The Oenochromatinae and Ennominae are absent, although *Gargaphia* (Ennominae) is present on Auckland.

Also, in the North and South Islands, such shrub genera as *Dracophyllum*, *Coprosma*, and *Hebe* (all present on Campbell) support very characteristic groups of geometrids: on *Dracophyllum longifolium* and its allies are found *Declana glacialis* Hudson, *Xanthorrhoe dissimilis* Philpott, and *Epiphryne charidema* (only the last species is found on Campbell); on *Coprosma* spp. are found four species of *Eucymatoge*, *Xanthorrhoe cedrinodes* Meyrick, *Chloroclystis sandycias* Meyrick, *Hydriomena callichlora* (Butler) and *H. similata* (again, only the last is on Campbell); *Hebe* species support a large group of *Chloroclystis* species (the ♂♂ possess long-fasciculate antennal segments), and *Epirrhanthis veronicae* Prout (none are present on Campbell, but one species is present on Auckland Is.).

Campbell and Auckland Is. have similar faunae, but that of Auckland Is. is slightly larger. Species or species groups common to both are: *Hydriomena similata*, *Epiphryne charidema*, the *Chloroclystis* sp. near *suffusa* group, *Xanthorrhoe orophylloides*, and the *Xanthorrhoe oxyptera-campbellensis* group. As a general rule, Campbell I. specimens are smaller and duller than Auckland I. ones.

It has not been possible in the short time available to elucidate fully the status of the subantarctic *Chloroclystis* species. On Campbell I. there are two closely related species (impossible to distinguish with complete accuracy on superficial characters) with apparently overlapping flight seasons but with obvious genitalic differences. Both are clearly related to one Auckland Is. species which is doubtfully distinct from a mainland species. On Campbell the typical form (sp. near *suffusa* Hudson) differs from the Auckland Is. population only in the slight reduction of the comb at the apex of the ductus bursae. The other type, described as *impudicis* n. sp., is endemic and shows great reduction of the comb, loss of the spinose signum bands, and, in the ♂, a reduction in the length of the 8th abdominal segment and obsolescence of the octavals. The ♂♂ of this species are characterized by the presence of straw-colored coremata1 scales projecting beyond the apex of segment 8. This character is unique, so far as is known. All other *Chloroclystis* spp. examined have the ♂ genitalia completely enclosed by the elongate segment 8. All three populations (*impudicis*, Campbell I. and Auckland I. sp. near *suffusa*) have the labial palpi over 1.9× as long as the compound eye, and the ♂♂ have the antennal segments evenly ciliate in a broad ventro-lateral band, as in the mainland specimens of sp. near *suffusa*. No specimens resemble the type of *C. semialbata* Walker, in which the octavals are double-apexed, and the valvae have a hairy lobe near the base, on the unsclerotised valvula. These characters are also absent in other *Chloroclystis* species examined, but are present in *Phrissogonus testulatus* auctt.

Xanthorrhoe orophylloides occurs on both Auckland and Campbell Islands. There are no distinct characters separating the two populations and Salmon's *subantarctica*, based on the Campbell population, is here synonymised. It is therefore surprising that I am forced to split *X. oxyptera*; there is a distinct morphological difference between the two populations in the valva structure of the ♂. (In both *orophylloides* and the *oxyptera* group, ♀♀ were available from Campbell only.) *X. oxyptera* and *X. campbellensis* are the only known brachypterous New Zealand subantarctic Geometridae. Salmon (1956) points out that brachyptery may not of itself be solely accounted for by the environment of the subantarctic islands, and "that there must have been firstly in these moths a genetic tendency towards brachyptery." The closest relatives (on genitalic structures) to the *oxyptera* group are those species with more or less narrowed wings: *X. helias* Meyrick, *X. exoriens* Prout, *X. nephelias*

Meyrick, *X. sericodes* Meyrick, and *X. imperfecta* Philpott. These in turn are closely related to *X. aegrota* Butler. The closest relatives of *X. orophylloides* are *X. orophylla* Meyrick, *X. rosearia* Doubleday and *X. semifissata* Walker, all of which, like *X. orophylloides*, have broadly triangular wings.

It would be useful to find out what differences in ecology there are between *X. campbellensis* and *X. oxyptera*, and between *Chloroclystis* sp. near *suffusa* and *C. impudicis*. If it is considered that *impudicis* has been derived from near-*suffusa*, it can be concluded that Campbell I. has been invaded twice (at least by *Chloroclystis*), and that the first invasion took place sufficiently long ago for specific integrity to have arisen (in *impudicis*), and to have been maintained during and after a later invasion from the same source.

Table 1 lists the numbers of genera and species of Geometridae recorded from Campbell, Auckland, and Stewart Islands. As well as having a small geometrid fauna, Campbell also has a very small flora – 10 shrub spp., 44 dicotyledonous herb spp., 19 ferns (Allan, 1961). It is debatable whether many geometrid species never reached Campbell I. but could have survived if they had, or whether they did reach it but were wiped out by some climatic factor. If wind still plays a part in bringing moths to the island, then the Bishop Museum collection, gathered as it was over three years, would have provided some evidence. As it is, the larval collections neatly balance the adult collections; there appear to be no strays in the Geometridae.

Table 1. Number of genera and species of Geometridae on subantarctic and Stewart Islands.

	Campbell I.	Auckland Is.*	Stewart I.*
Genera	4	5	21
Species	6 (2 endemic)	8 (2 endemic)	40 (2 endemic)

(* records from Hudson, 1909, 1928, 1939; Meyrick, 1909; Salmon, 1956; Forest Research Institute collections.)

Although the collection amassed by the Bishop Museum has brought to light only one previously unknown species, it constitutes, in conjunction with the Cape collection, a worthwhile sample of the fauna. Unfortunately Bishop Museum specimens are in a poor state of preservation and can best be used for genitalic studies. It is to be hoped that in later expeditions to such places there will be some improvement in the handling of Lepidoptera. The 28 tubes of larvae comprise a valuable, and apparently comprehensive series. In future expeditions, there should be facilities for rearing a percentage of the larvae found. This is particularly useful in cases where (as on Campbell) sibling species occur. In this paper, only the larvae that can with confidence, based on experience with mainland populations, be assigned to species are described. The rest are listed in a key, with suggestions for assigning them to genera.

Terms used in descriptions of genitalia are those advocated by Klots (In Tuxen 1956). Chaetotaxy and abbreviations for larval structures are as in Dugdale (1961). Authorities for plant genera and species are from Allan (1961). Abbreviations in the text are: BISHOP–Bernice P. Bishop Museum, Honolulu; BMNH–British Museum (Natural History), London; WDM–Dominion Museum, Wellington; RoFo: Forest Research Institute, Rotorua.

Hydriomena similata (Walker) Figs. 1–8.

Cidaria similata Walker 1862, Cat. of Lepidopt. in the British Mus. (N. H.) **25**: 1413.
Cidaria timarata Felder, 1864, Reise der Frigatte Novara, plate 132, fig. 19. Holotype ♂ in British Museum (Natural History).

♂ *genitalia* (figs. 1–6): Uncus uniformly slender, curved, longer than juxta. Socii absent, subscaphium lightly sclerotised, forked, apically weakly to obsoletely scobinated, scobinations in transverse rows. A simple transverse bar below subscaphium extends across diaphragma joining margins of tegumen. Fultura superior developed as a pair of long-haired cones, set wide apart. Juxta shaped as figured, covered with long, capitate scales. Valva with valvula covered in similar scales, and an admixture of short curved setae. Costa of valva strong, ending in a sickle-shaped spur at base of which is a shorter, blunt spur of variable length. Sclerotisation of valva indicated by stippling in the figure.

Aedeagus almost as long as costa, rather smaller in some southern specimens, with 12–15 short stout cornuti and a row of 9–12 smaller cornuti. Manica heavily scobinate, scobinations largest dorsally and again laterally.

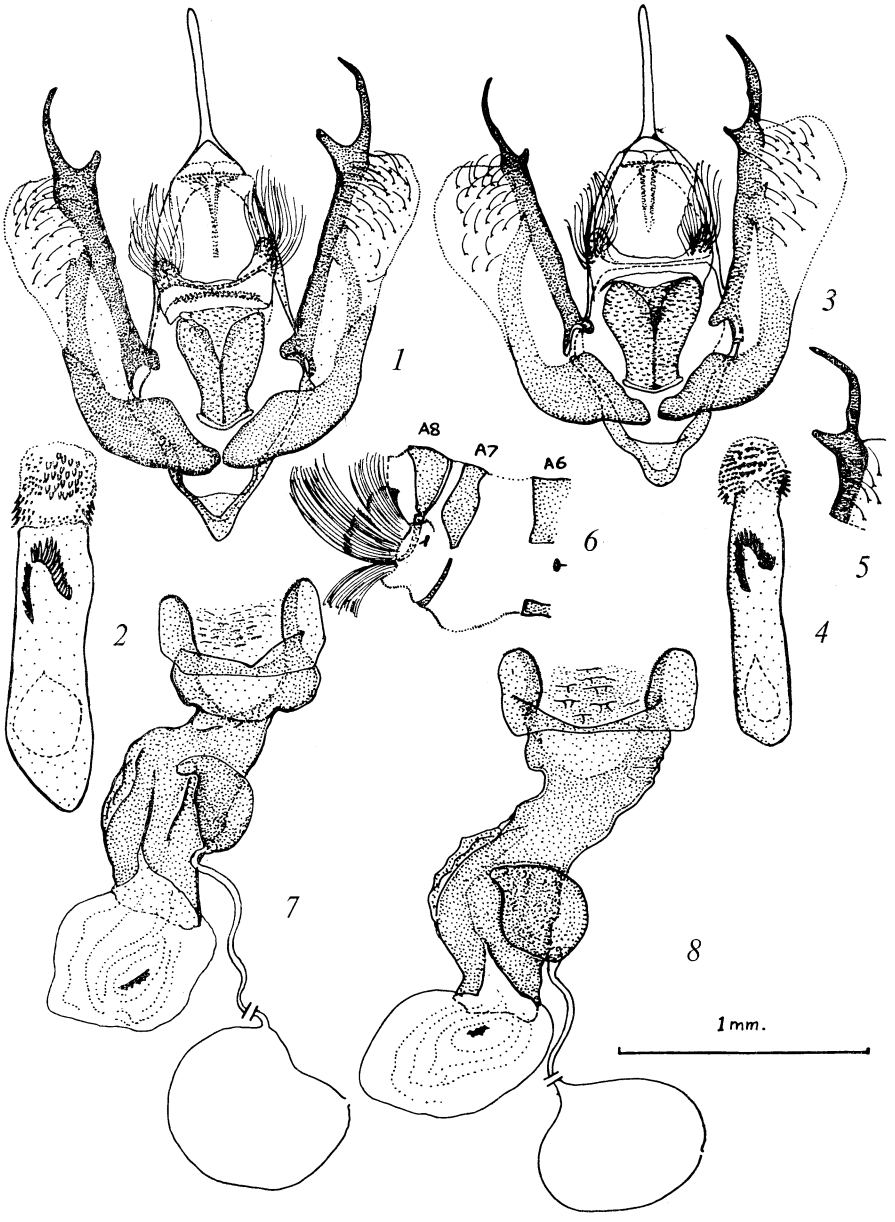
The A7 sternite and tergite are separate; posterior to sclerites, and laterally, an eversible lobe bearing 3 hairpencils and spiracle. The 2 more dorsal hairpencils with long and short ascending 'hairs'; ventral pencil with short decurved 'hairs.' A8 tergite not over 2 × length of A7 tergite dorsally; both withdrawn into A6, with tip of A8 showing, at rest.

♀ *genitalia* (figs. 7–8): Ovipositor lobes short, merging into intersegmental membrane antero-laterally and ventrally. Lamellae surrounding ostiole as figured. Some variation in width of lamella anterovaginalis, and variation in rugosity of the scarcely sclerotised rudimentary lamella postvaginalis. Ductus bursae broad, heavily sclerotised; basal portion of ductus seminalis flask shaped, arising at 1/2 length of ductus bursae, heavily sclerotised; rest of ductus seminalis unsclerotised, expanding at length into a very large seminal vesicle. Corpus bursae oval, set at right angles to ductus bursae, with signum present as a few moderate to obsolete scobinations.

Larva: Instars IV–V with all D, SD and L setae tuberculate; crochets of prolegs in unbroken, irregularly biordinal mesoseries, shortest in center; a dorsal prominence, increasing in size per segment posteriorly on abdominal segments 1–5, arising between setae D_2. These prominences are white/grey anteriorly. Each ocellus margined with a heavily sclerotised ring. All instars with seta SV_2 on A_1, SD_2 seemingly absent on A1–8, and all instars with a ventro-apical protruberance on anal shield. Anal shield with 4 marginal pairs of setae; D_1 posterior to SD_1. Ventroapical protruberance on anal shield serves to distinguish all instars of this species from larvae of other Geometridae on the island.

MATERIAL EXAMINED. (a) Adults: CAMPBELL I. 4♀♀, 2♂♂, Beeman Cove, 10 m, 4. V.1962, C. M. Clark; 1♀, *ibid.*, 6.X.1962, Clark (WDM); 1♀, Tucker Cove, malaise trap, 5–8. XII. 1961, J. L. Gressitt; 1♀, Beeman Camp, 2–50 m, 6–11. XII. 1961, K. P. Rennell; 1♀, *ibid.*, 2. VIII. 1962, Rennell; 1♂, 1♀, *ibid.*, 2. V. 1962, Rennell; 1♂, *ibid.*, 20. V. 1962; 1♂, *ibid.*, 29. X. 1962; 1♂, *ibid.*, 6. IV. 1962, Rennell; 1♀, *ibid.*, 4. II. 1963, Rennell; 1♂, Mowbray Hill, 2. III. 1963, K. A. J. Wise (BISHOP).

(b) Larvae: 1 instar III, Tucker Cove, 1–50 m, 26–30. XI. 1961, ex *Coprosma*, Gressitt; 1 instar III, Tucker Cove, 1.XII.? 1961, ex *Juncus* Gressitt; 1 instar I, Beeman Hill, 180 m, 2–6.XII.1961, ex *Coprosma*, Gressitt; 1 instar I, Beeman, 15.VIII.1962, ex *Coprosma*, Rennell;



Figs. 1–8. *Hydriomena similata.* 1, ♂ genitalia, ventral view (North Island); 2, aedeagus, ventral view; 3, ♂ genitalia, ventral view, Campbell I. (Beeman Camp, 2. V. 1962, Rennell); 4, aedeagus, ventral view; 5, apex of valva costa, Campbell I. (Moubray Hill, 2.III.1963, Wise); 6, ♂ abd. segs. 7 & 8, and scale tufts (diagrammatic); 7, ♀ bursa copulatrix (North Island); 8, *ibid.*, Campbell I. (Beeman Camp, 4. II. 1963, Rennell).

1 instar III, 1 instar IV, St. Col+Beeman, 7. XII. 1961, ex *Coprosma* (Photo No. 1), Rennell; 1 instar IV, Beeman Hill, 2. II. 1963, K. A. J. Wise (BISHOP); 2 instar V, 2 instar IV, 1 instar II, Tucker Cove, 13. VIII. 1962, ex *Dracophyllum*, Clark (WDM).

Host plants: *Coprosma robusta* Raoul; *C. propinqua* A. Cunn.; *C. areolata* Cheeseman; *C. rigida* Cheeseman; *C. pseudocuneata* Oliver; *C. cunninghamii* Hook. f.; *C. rotundifolia* A. Cunn.; *C. ciliata* Hook. f.; *C. rhamnoides* A. Cunn.; *C. parviflora* Hook. f.; *C. linariifolia* Hook. f. (mainland areas) (RoFo records).

DISTRIBUTION.: Campbell I.; Auckland Is.; Stewart I.; sea level to scrub line, South and North Is.

First recorded from Campbell I. by Hudson (1909) as specimens of a moth near to *H. similata* but too worn to be described; Salmon (1956) could not differentiate Sorensen's Campbell specimens from mainland specimens. On genitalia and larvae no consistent differences were seen except that the aedeagus is smaller and the juxta is broader in Campbell I. specimens. Hudson's figure (1928, plate II, f. 2) of the larva, and his description and figure (1928, p. 99, pl. XII, f. 46) of the adult are adequate for color and shape.

Fletcher (pers. comm.) notes that while *H. similata* is at present placed in *Euphyia* in the British Museum collection, he considers it closer to a South African genus which also has Oriental members. As the issue is in doubt, it is best to leave *similata* in *Hydriomena* for the present until further work is done on the revision of geometrid genera. *H. similata* is restricted to *Coprosma* spp., but will 'stray' on to other vegetation in the vicinity of the host plant. The adult is nocturnal.

Genus **Epiphryne** Meyrick 1884

Epiphryne Meyrick, 1884, Trans. & Proc. N. Z. Inst. **16**: 60.
Hermione Meyr., 1884 *Ibid.* **16**: 61 (praeocc.). Type: *xanthaspis* Meyrick.
Panopaea Meyr., 1884 *Ibid.* **16**: 62 (praeocc.). Type: *verriculata* Felder.
Aulopola Meyr., 1886, *Ibid.* **18**: 184 (replacing *Hermione*).
Pancyma Meyr., 1886, *Ibid.* **18**: 184 (replacing *Panopaea*).
Venusia nec Curtiss, 1839: British Entomology, p. 759.—Meyrick, 1917, *Ibid.* **49**: 257. Type (Curtiss): *cambrica* Curtiss.

Typus generis: *Epiphryne undosata* Felder.

This generic name is resurrected because the ♂ and ♀ genitalia do not agree with those of *Venusia cambrica* as illustrated by Pierce (1914). Fletcher (pers. comm.) includes *charidema* Meyrick in *Aulopola* but an examination of *xanthaspis*, *verriculata*, *charidema*, and *undosata* genitalia showed that the features listed below were held in common. *Orthoclydon praefactata* (Walker) and *O. chlorias* Meyrick were also examined; these species differ from the *Epiphryne* group in the modification of the cristae (*sensu* Pierce, 1914) as a diffuse hairy pad, rather than the characteristic bulbous crista base with long, sigmoid, posteriorly projecting setae of *Epiphryne*.

♂. Uncus elongate, apex strongly forked; saccus rounded, large. Labides, slender irregular laths with a complex, often palmate apex; furca elongate, cristae prominent each with 1–3 or many posteriorly directed appressed setae; manica spinose. Valvae elongate, costa wavy or straight; sacculus short, with a fringe of strong setae. Aedeagus variable but with a sharp apex.

♀. Ostiolar lamellae fused, forming a wide deep pit; ductus bursae very short, corpus bursae elongate, globose, unornamented.

Differs from *Venusia* Curtiss in its possession of a strong uncus, different type of labides, possession of cristae, very short sacculus, unornamented corpus bursae. The genus comprises *E. undosata*, *E. verriculata*, *E. xanthaspis*, *E. autocharis* Meyrick, and *E. charidema*.

2. **Epiphryne charidema** (Meyrick), n. comb. Figs. 9–12, 14.

Venusia charidema Meyr., 1909, Subantarctic Islands of N. Z. **1**: 70. Holotype ♂ in coll. British Museum (Nat. Hist.), London.

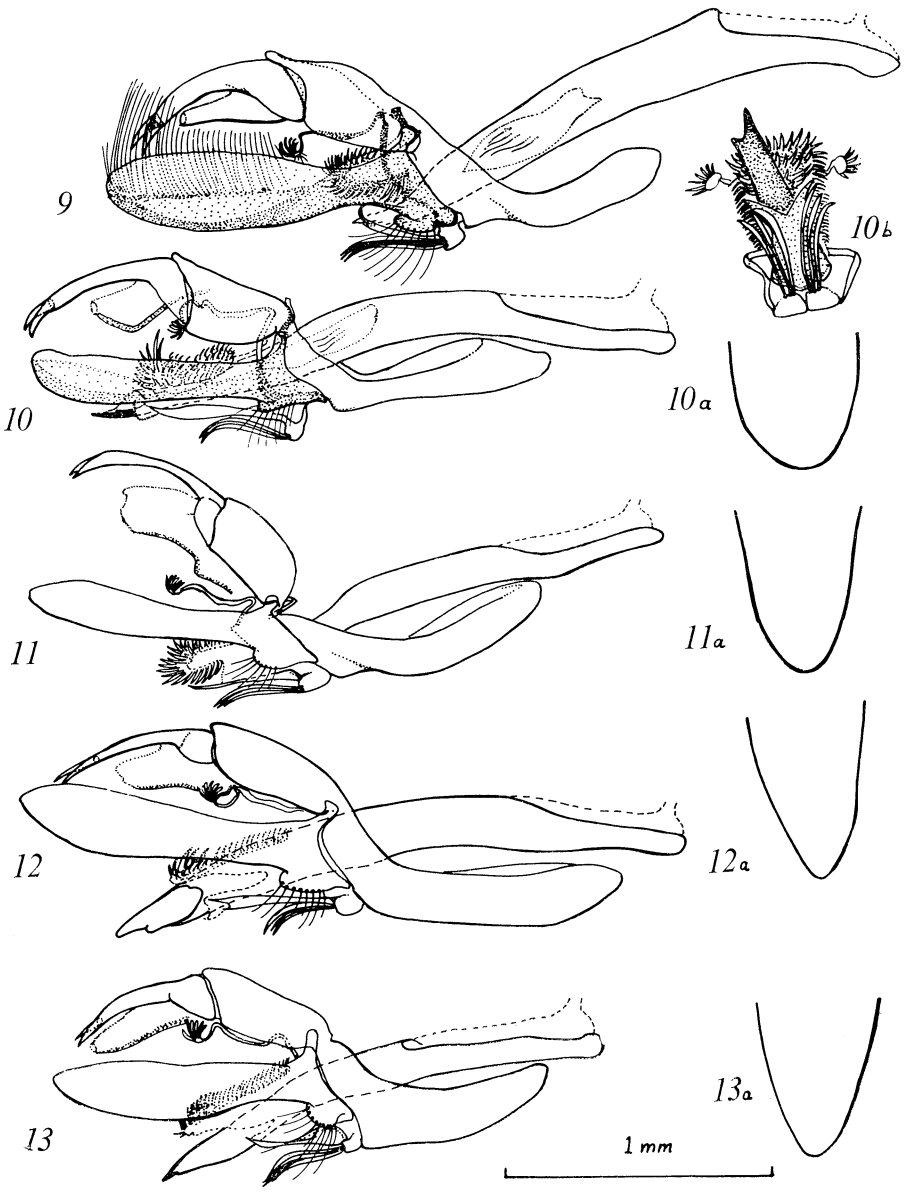
♂ *genitalia* (fig. 9, 9a): Uncus forked at apex, forks 1/4 length of rest of uncus; saccus basal length greater than entire uncus length; saccus apex broadly rounded. Tegumen joined just above costal articulation by a narrow bar. Subscaphium diffuse, weakly sclerotised. Valva elongate oval; costa wide, to apex. Setae on inner face of valva longest subapically. Base of sacculus swollen, fringed with a single marginal series of long curved strong setae.

Annellar structures complex and prominent. Annellus a narrow circlet, with labides present as palmate structures on a pair of irregular stalks. Juxta as figured (fig. 9a) with prominent cristae beyond base, each bearing 3 curved, appressed, flattened setae as long as juxta. Manica thorny, longest thorns apically; basally the thorns are slender, short, densely packed. Aedeagus with a plate-like cornutus (possibly representing several fused cornuti). Apex acuminate. Length slightly longer than length of genitalia (from valva tip to saccus tip).

♀ *genitalia* (fig. 14): Ovipositor not greatly protrusible; ovipositor lobes shortly setose, inner margin emarginate. Ostiole encircled; chamber formed by antero- and postero-vaginal lamellae deeper than ductus bursae is long; tapering. Postero-vaginal lamella with an apical elongation on midline, margin irregular. Ductus bursae heavily sclerotised, 1/4 length of corpus bursae. Ductus seminalis arising at junction of ductus bursae and corpus bursae, ventrally, unsclerotised. Corpus bursae unsclerotised, ovoid.

Larva: Head capsule in instars I–IV with a darkened area ± strongly developed on apex of each parietal lobe; instar V usually with this dark zone absent. Eyes unmargined by sclerotisation in all instars. SV_2 absent on A_1; SD_2 antero-ventrad of SD_1 pinaculum on A_1, directly ventrad of SD_2 on A_{2-8}. All D, SD and L pinaculae oval. Anal shield rounded, wider than long; seta D_1 well posterad of SD_1. All spiracles slightly raised, with a narrow sclerotised margin. Setae long, strong; dorsal setae black; ventral setae paler. Foreleg claws shielded by a chordate scale longer than claw. Proleg crotchets arranged in a mesoseries, on A6 with central 1/3 consisting of alternate hooks and stumps, on A10 with central 1/3 consisting of stumps only. Body smooth. Color pattern: Prothoracic shield darkened; body dark ?green with dorsal midline pallid, and a pallid stripe along line of D setae; another, wider pallid band between setae L_{1-2} and L_{3-4}, below the spiracle; subventral and ventral regions not as dark as dorsal dark areas. Body shape: cylindrical, becoming flattened posteriorly.

MATERIAL EXAMINED. (a) *Adults*: 2♂♂, Campbell I., late autumn 1960 (no name); 1♂, Campbell I., 23. II. 1957, R. M. Smith; 1♂, Beeman Cove, 2. X. 1962, Clark; 1♂, *Ibid.* 4. V. 1962, Clark; 1♂, Garden Cove, 6.IX.1962, Clark (WDM); 1♀, Beeman Camp, 18–21.



Figs. 9–13. 9, *Epiphryne charidema*, ♂ genitalia, lateral view (Campbell I.); 10, *ibid.*, Hollyford Valley; 10a, *ibid.*, saccus apex shape, ventral view; 10b, annellar structures, manica and aedeagus tip; 11, ♂ genitalia, lateral view, Hopkins Valley; 11a, *ibid.*, saccus apex; 12, ♂ genitalia, lateral view, Cobb Valley; 12a, *ibid.*, saccus apex; 13, *E. autocharis*, ♂ genitalia, lateral view, Mt. Ruapehu (North Island); 13a, *ibid.*, saccus apex.

XII. 1961, Gressitt; 2♂♂, *Ibid.*, 13. II. 1963, Wise; 1♀, *Ibid.*, 12. III. 1962, Rennell; 1♂, *Ibid.*, 4.II.1963, Rennell; 2♀♀, *Ibid.*, 2–3.VIII.1962, Rennell; 1♂, *Ibid.*, 13. VIII. 1962, Rennell; 2♂♂, *Ibid.*, 2. V. 1962, Rennell; 1♂, *Ibid.*, 2. VIII. 1962, Rennell; 1♂, 2♀♀, *Ibid.*, 6. IV.1962, Rennell; 1♂, *Ibid.*, 11.II.1963, Wise; 1♀, Mt. Honey-Puiseux Saddle, 12. XII. 1961, Gressitt; 1♂, 1♀, Tucker Cove (malaise trap), 1–3. XII. 1961, Gressitt; 1♂, *Ibid.*, 18–21. VII. 1961, Gressitt (BISHOP).

(b) *Larvae*: 1 instar I, Beeman, 3.VIII.1962, ex *Coprosma*, Rennell; 1 pupa, 1 instar V, *Ibid.*, ex *Dracophyllum*; 1 instar III, 2 instar IV, 3 instar V, Beeman Point, 25. XII. 1963, ex *Dracophyllum scoparium*, Wise; 1 instar IV, Tucker Cove, 22.XI. 1961, ex *Dracophyllum*, Gressitt; 1 instar V, Beeman Hill, 11. II. 1963, Wise; 1 instar V, 1 instar IV, 2 instar II, Lookout Bay by beach, 3.XII.1961, ex *Dracophyllum*, Gressitt; 1 instar V, Beeman Hill, 21–25. XI. 1961, Gressitt; 2 instar III, 1 instar V, Beeman Hill, 2. II. 1963, Wise; 2 instar V, Beeman Hill, 6.XII.1961, ex *Dracophyllum*, Gressitt (BISHOP); 1 instar V, 1 instar IV, Tucker Cove, 13. VIII. 1962, ex *Dracophyllum*, Clark (WDM).

HOST PLANTS: *Dracophyllum longifolium* (J. R. et G. Forst.); *D. scoparium* Hook. f.

DISTRIBUTION: Campbell I.; Auckland Is.; South Island.

In mainland populations, the parietal lobes are not darkened, and the foreleg claws are not overshadowed by the apical 'scale', which is ovate rather than chordate, and not longer than the claw.

Genitalia of ♂♂ from Upper Hollyford, Hopkins Valley, Cobb Valley (South I.) and of *autocharis* from Mt. Ruapehu (North I.) were also examined (figs. 10–13) and in comparison with Campbell and Auckland Is. material the following differences were noted:

Table 2. Comparison of structures in *E. charidema—E. autocharis* group (♂ genitalia only).

	Ratio uncus length: saccus base length	Saccus apex shape	Aedeagus length	Valva shape
Campbell I.	1 : 1.1	broadly rounded	slightly longer than valva+saccus	elongate oval, neck pronounced
Auckland I.	1 : 1.1	ditto	ditto	ditto
Hollyford	1 : 1.3	ditto	ditto	±strap-like, no neck
Hopkins Valley	1 : 1.4	intermediate	shorter	±strap-like, no neck
Cobb Valley	1 : 1.5	sub-acute, narrowly rounded	equal	narrow elongate oval, slight neck
Ruapehu (*E. autocharis*)	1 : 1.3	sub-acute, narrowly rounded	subequal	ditto

In many respects the North I. population (*E. autocharis*) more closely resembles the Campbell and Auckland I. populations than these populations resemble South I. forms. This study indicates that there is close affinity among all populations, and, compared with the

differences between this species and others in the genus, the differences in the table are slight. I do not regard the evidence conclusive, however, since no ♀♀ were available. *E. charidema* is here regarded as including all South I. populations. As there is not enough material to determine the status of *E. autocharis*, this species is not synonymised here.

3. **Xanthorrhoe campbellensis** Dugdale, n. sp. Figs. 15, 19.

Xanthorrhoe oxyptera (*nec* Hudson) Salmon, 1956, Rec. Dom. Mus. (Wgton.) **3** (1) : 63.

Holotype ♂, allotype ♀ in type collection, Entomology Division, D.S.I.R., Nelson; paratype ♂, ♀ in colln. Dominion Museum, Wellington.

♂ *genitalia* (fig. 15) : Uncus elongate, apex blunt, gnathos obsolete. Valva complex, with opposed costal and saccular processes. Costal process a rounded, massive projection, minutely scobinate outwardly and apically. Saccular process a bent arm with an obscurely pronged apex; saccular arm projecting above and beyond costal process. Unsclerotised apical portion of valva blunt, sparsely setose. Annellar structures in 2 parts : juxtal region and the labides. Juxtal region with a small juxtal plate; anterior to this is a wider, paired horned structure bearing two small hairy pads. Labides extending around aedeagal orifice, apical 1/3 setose, wider than basal section. Saccus moderately narrow. Aedeagus stout, widest apically. Manica spinose, spines longest nearest aedeagus.

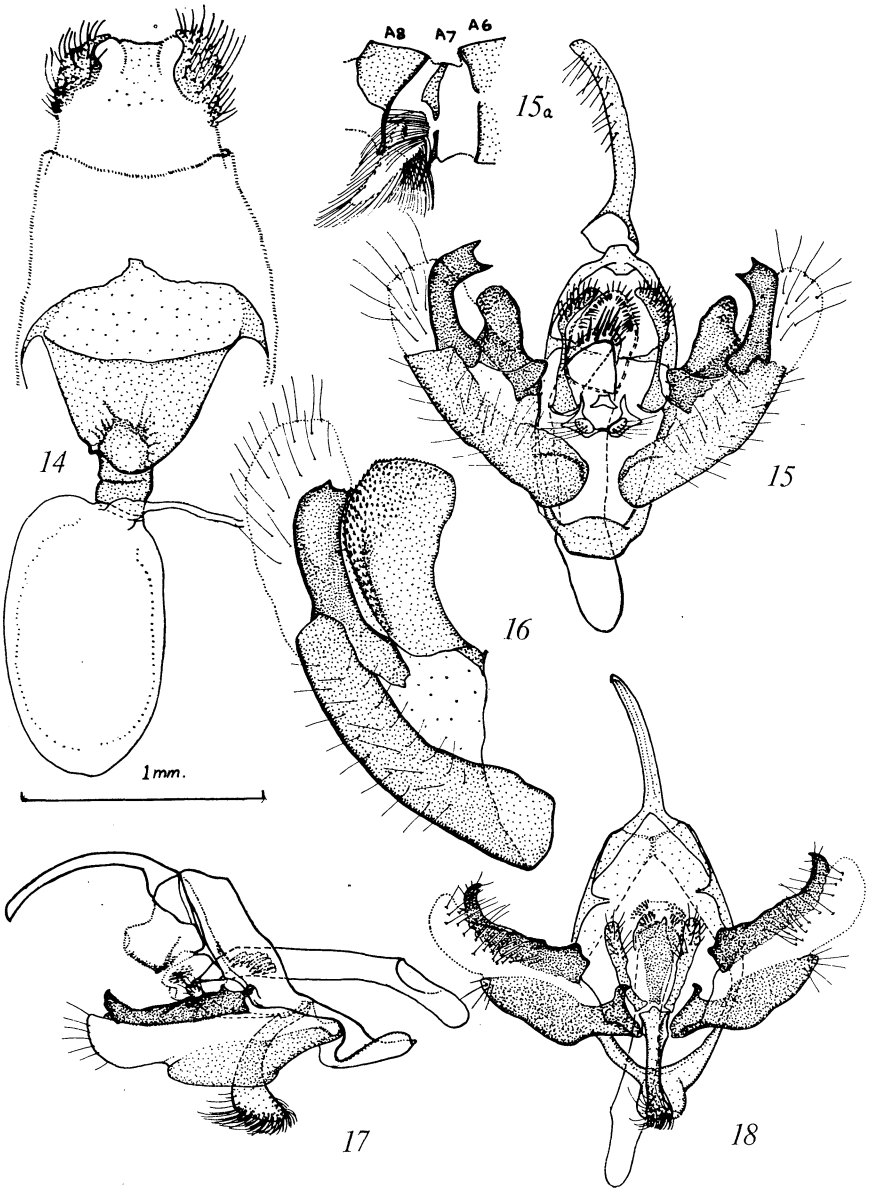
♀ *genitalia* (fig. 18) : Ovipositor lobes extrusible, oval, setose. Ostiole encircled, prevaginal chamber basin-like, lamellae lightly sclerotised. Ductus bursae strongly bent on itself, not quite as wide as base of lamella. Corpus bursae globose, unornamented. Ductus seminalis apparently arising dorsally, but duct opening at side of ductus bursae on bend.

Holotype ♂, Shoal Pt., sedge/tussock by sea-elephant wallow, 7. II. 1963, K. P. Rennell. Allotype ♀, Beeman Camp, 29. VIII. 1962, Rennell.

MATERIAL EXAMINED : 2♂♂, Garden Cove, 6.IX.1962, Clark; 1♂ Courrejolles Peninsula, 200 m, 12. III. 1962, Clark; 1♂, St. Col Ridge, 250 m, 6. X. 1962, Clark (WDM); 2♂♂, Station, early X. 1959, J. Shaw; 1♂, Mt. Azimuth, 14. XII. 1961, Gressitt & Rennell; 1♂, Shoal Pt., sedge/tussock by sea-elephant wallows, 7. II. 1963, Rennell; 1♂, Lookout Bay, beach, 3.XII.1961, Gressitt; 1♂, Lookout Bay, 3. II. 1963, Wise; 1♂, *Ibid.*, 2.III.1963, Wise; 1♂, shore of Six Foot Lake, 9. II. 1963, Rennell; 1♂, Beeman Camp, 14. II. 1963, Rennell; 1♂, west slopes Mt. Dumas, 300 m, 23. XI. 1962, Rennell; 1♂, Mt. Dumas, 20. XII. 1961, Gressitt; 1♂, Northwest Bay, 5. V. 1963, Wise; 1♂, Tucker Cove, 30 m, 7. VIII. 1962, Rennell (BISHOP).

DISTRIBUTION : Campbell I.

As no ♀♀ of *X. oxyptera* were available, this new species is distinguished from *X. oxyptera* by ♂ characters. The proportions of the various parts of the costa and sacculus are quite different in the 2 species (figs. 15, 16). There are no reliable external differences. *X. oxyptera* is larger than *X. campbellensis*, but this is the general rule in the subantarctic Geometridae. One Campbell I. ♂ is comparable in size with *oxyptera*, but the genitalia are characteristic for *campbellensis*. *X. campbellensis* is very variable in the dorsal and ventral wing color patterns, the marginal shade being present or absent, the discal dot varying from strong to obsolete to absent, and the ground color varying from yellow-straw to dark fawn. The ventral discal stripe is also variable on both wings. Salmon (1956, pp. 61–62) has given an account of brachyptery in subantarctic moths, and the subject has also



Figs. 14–18. 14, *E. charidema*, ♀ genitalia, ventral view; 15, *Xanthorrhoe campbellensis* n. sp., holotype ♂, genitalia in ventral view; 15a, ♂ abd. segs. 7 & 8 (diagrammatic); 16, *X. oxyptera* Hudson holotype ♂, right valva; 17, *X. orophylloides* Hudson, ♂ genitalia, lateral view (Campbell I.); 18, *ibid.*, ventral view (Campbell I.).

been discussed above. Salmon's description of the ♀ *oxyptera* refers to *campbellensis.*

4. **Xanthorrhoe orophylloides** Hudson Figs. 17, 18, 20.

Xanthorrhoe orophylloides Huds., 1909, Subantarctic Is. of N. Zeal. **1**: 68.
Xanthorrhoe subantarctica Salmon, 1956, Rec. Dom. Mus. (Wgtn.) **3**(1):80. **New Synonymy.**

Holotype ♂ in Hudson Colln., Dominion Museum, Wellington. Allotype ♀ in colln., Dominion Museum (Cape Expedition Colln.).

♂ *genitalia*: Uncus elongate, apex chisel shaped. Tegumen with a pair of inwardly projecting tapering fingers above annellar structures. Valvae with a heavy, thick, sclerotised costa; apex of costa free, upturned, unsclerotised portion of valva projecting as a lobe between costa and sacculus, apex rounded. Sacculus broad, tapering to apex. Annellar structures complex, consisting of lateral labides, broadest apically, sparsely setose on apical 1/2; a median, elongate juxtal plate, lightly sclerotised and finely scobinate; a median, ventrally projecting calcar with ± developed dorsal ridges, its apex bearing recurved dense setae. Saccus expanded. Manica with dorso-lateral groups of spines. A7 with separate, narrow tergite and sternite; and with long-haired protrusible lobes. A8 tergite long, A8 sternite fused, slender.

♀ *genitalia*: Ostiolar chamber cup-shaped; ostiole encircled, lateral arms broad. Postero-vaginal lamella long, antero-vaginal lamella short, lip formed of an emarginate unsclerotised fold. Ductus bursae somewhat narrowed in middle, wider than ostiole opening and enclosing it by lateral and dorsal 'shoulders'; sclerotised portion of ductus (?cestum) split ventrally, elongate, with pronounced lateral fold; corpus bursae unsclerotised, globose, signum absent. Ductus seminalis arising at junction of corpus and ductus bursae.

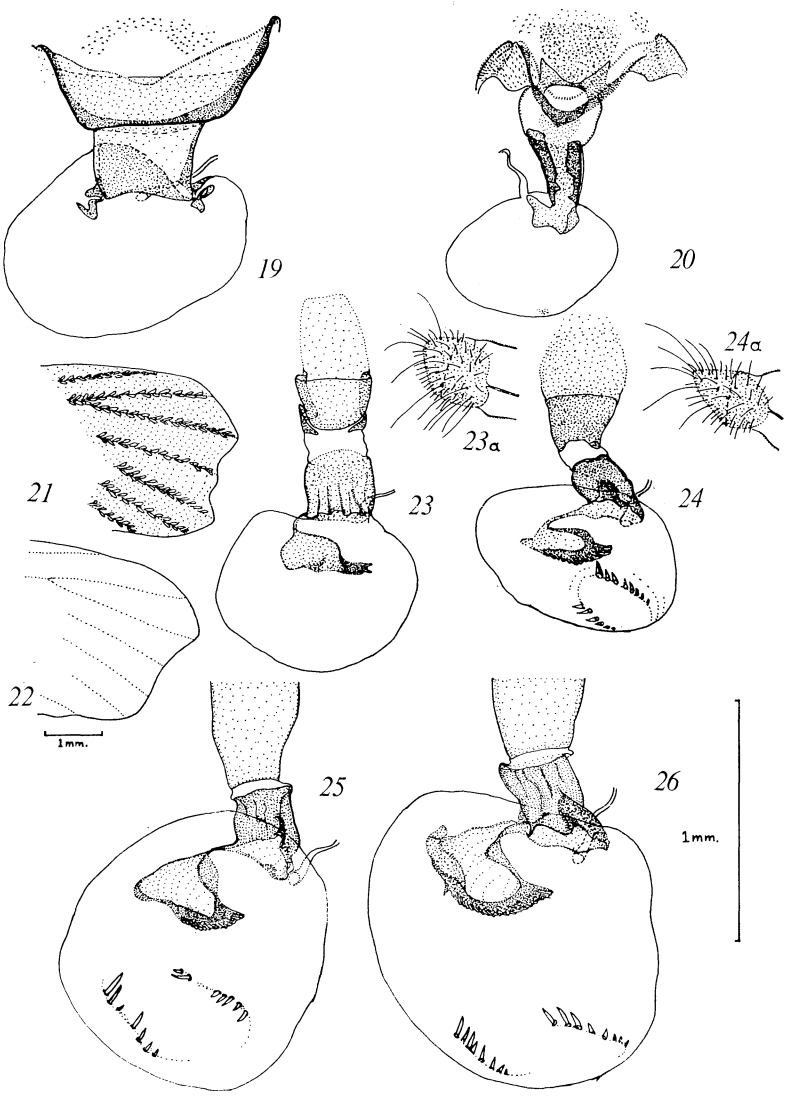
MATERIAL EXAMINED: Holotype ♂ Auckland Island (*orophylloides* Hudson); Holotype ♂ and allotype ♀ (*subantarctica* Salm.) Campbell I.; 1♂, Mt. Dumas, Campbell I., 550 m, 4. X. 1962, Clark (WDM); 5♂♂, Beeman Camp, 5–15. II. 1963, Rennell & Wise; 1♂ *Ibid.*, 22.XII.1961, Rennell; 1♂, 1.8 m Lake, 9.II.1963, Rennell; 1♂, Tucker-Station Col, ex *Carex trifida*, 30. XI. 1963, Gressitt; 1♂, Garden Cove, 27. VIII. 1962, Rennell; 1♂, Shoal Pt., ex sedge, 7. XI. 1963, Rennell (BISHOP).

DISTRIBUTION: Campbell I., Auckland I.

Similiar in color pattern and genitalia to *Xanthorrhoe orophylla* and *X. semifissata.* There are specific differences in valva proportions, costal structure and ostiolar/ductus bursae sclerotisation. Salmon (1956) regarded *X. subantarctica* Salmon as distinct from *X. orophylloides*, but did not examine the genitalia, which show no consistent differences between specimens from the two islands (cf. *X. oxyptera*, *X. campbellensis*, above). The intensity of wing markings, especially the diagonal, is variable. As in *Chloroclystis* spp. and *X. campbellensis*, Campbell Island specimens are smaller than their Auckland Island counterparts.

5. **Chloroclystis** sp. near **suffusa** Hudson Figs. 21, 24–26, 28, 29.

Chloroclystis indicataria (*nec* Walker) Hudson, 1909, Subantarctic Is. of N. Zeal., **1**: 61, 65 (=*C. semialbata nec* Walker, *sensu* Meyrick, 1917).
Chloroclystis indicataria (*nec* Walker) Meyrick, 1909, *Ibid.*, 70.



Figs. 19-26. 19, *X. campbellensis* ♀, allotype, bursa copulatrix, ventral view; 20, *X. orophylloides* ♀ (*subantarctica* Salm. allotype), bursa copulatrix, ventral view; 21, *Chloroclystis* sp. near *suffusa*, outer margin of ♂ hind wing; 22, *C. impudicis* n. sp., *ibid.*, (scaling along veins omitted); 23, *C. impudicis* n. sp., ♀, bursa copulatrix, ventral view; 23a, ovipositor lobe, lateral view; 24, *C.* sp. near *suffusa*, ♀, bursa copulatrix, ventral view (Campbell I.); 24a, ovipositor lobe, lateral view; 25, *C.* sp. near *suffusa*, bursa copulatrix (Auckland Is.); 26, *C.* sp. near *suffusa*, bursa copulatrix (North Island).

Both sexes with labial palpi 2.0–2.4× as long as width of eye. ♂♂ with antennae ciliate laterally and ventrally, ciliae 1/2–3/4 as long as the segment is thick. Color pattern as illustrated by Hudson (1909, pl. II, figs. 20–22) for Auckland I. population, as illustrated here (fig. 29) for Campbell I. population. Male hind wings (fig. 21) with veins M_1, M_2, M_3 each ending on a 'tooth' on the margin, the M_2 'tooth' smaller than the others. Female hind wings with a pronounced 'tooth' at M_1, M_2 and M_3. All hind wing veins marked by long raised scales.

♂ *genitalia*: A8 tergite and sternite elongate, completely enclosing the genitalia; octavals slender, apices projecting a little beyond the segment, scythe shaped. Genitalia as figured. Complex annellar structures fused with a 'transtilla' formed from base of valva costa with ventral arms strap-like, sparsely setose, the lateral fusion area moderately coarsely (mainland and Auckland I.) or obsoletely (Campbell I.) scobinate. Complex labides densely setose. Aedeagus short, with at least 4 stout cornuti. Manica densely spinose; uncus short, triangular. Coremata present, densely scaled.

♀ *genitalia*: Ovipositor lobes elongate-triangular, with 4–5 very long lateral marginal setae, and 25–35 shorter setae, not less than 1/3 as long as the long setae. Ostiolar lamellae as figured, shorter than usual in Campbell I. specimens, weakly sclerotised, ostiole encircled. Ductus bursae short, its anterior margin with a small ventral scobinate flange and a large dorsal appendage, the inner margin of which bears numerous serrulations decreasing in size (mainland, Auckland I. population) or ± distinct teeth, grading into serrulations (Campbell I. population). Signum present as 2 arcs of 5–8 spines, of decreasing size. Corpus bursae globose.

MATERIAL EXAMINED: AUCKLAND I. 3♂♂, 2♀♀, Carnley Harbor, 19. XI. 1907 (G. V. Hudson); 1♀, Musgrove Peninsula, in pond, 21. VIII. 1941 (?collector) (WDM).

CAMPBELL I. 1♀, 'Summer, 1907/08 (Chambers & de Barres); 3♀♀, 1945, Sorensen; 1♀, in house, 6.XII.1944, Sorensen (WDM). 4♂♂, 5♀♀, Tucker Cove, ex malaise trap, 21. XI–21. XII. 1961, Gressitt; 1♂, Tucker Cove–St. Col. Ridge, 30. XI. 1961, Gressitt; 1♂, Middle Bay, 29. XI. 1961, Gressitt; 1♂, Beeman Camp, 15 m, 29.IX.1962, Rennell (BISHOP).

NEW ZEALAND: 1♂, 1♀, State Forest 90, Kaimanawa Range, North I., 7. XII. 1956, Dugdale; 1♂, Mt. Luxmore, 660 m (Lake Te Anau) 27. X. 1963, Kershaw (RoFo).

DISTRIBUTION: As above.

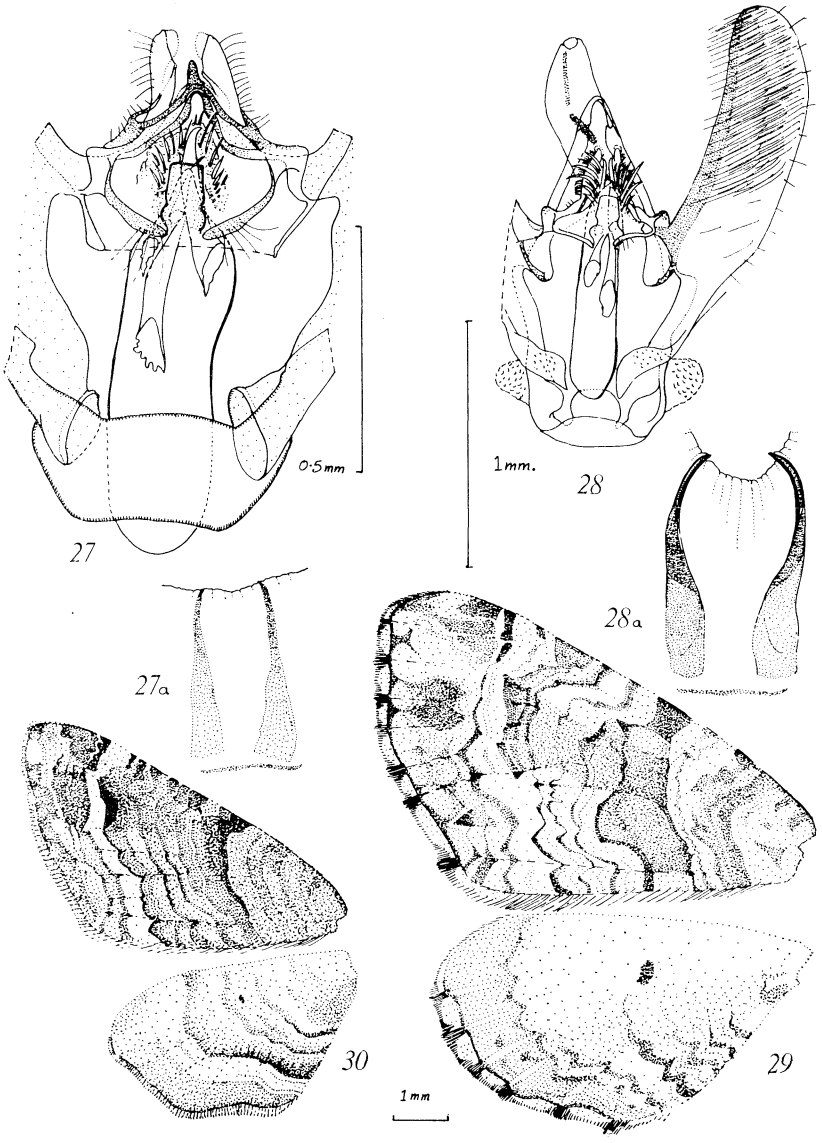
This species is the less common of the two *Chloroclystis* species collected on Campbell I. during 1961–63, being outnumbered by *C. impudicis* n. sp. by 5 : 1. It fits well into Hudson's group C of the New Zealand *Chloroclystis* species, characterised by the form of the ♂ antenna. It is not *C. semialbata*, which has octavals of a different shape, and a hairy prominence on the valva. I am indebted to Mr. D. S. Fletcher of the British Museum for preparing and sending me photographs of the *semialbata* type.

The species usually referred to as *C. semialbata* from the main islands, and figured by Hudson (1928, pl. XI, f. 5) differs from *C.* sp. near *suffusa* in the antennal structure and the length of the labial palpi, but is otherwise closely related.

6. **Chloroclystis impudicis** Dugdale, n. sp. Figs. 22, 23, 27, 30.

Chloroclystis aristias (*nec* Meyrick) Salmon, 1956, Rec. Dom. Mus. (Wgton) **3**(1) : 80.

Holotype ♂, allotype ♀ in coll. Entomology Division, D. S. I. R., Nelson; 2♀♀ para-



Figs. 27–30. *Chloroclystis* spp. 27, 27a, *C. impudicis*, ♂, aedeagus, annellar structures, and octavals (Campbell I.) (scale for octavals as for fig. 28); 28, 28a, *C.* sp. near *suffusa*, genitalia and octavals (Campbell I.); 29, *C.* sp. near *suffusa*, ♀, wing color pattern (Campbell I.); 30, *C. impudicis*, *ibid.*

types in coll. Dom. Mus., Wellington.

Superficially indistinguishable from the previous species, except for the ♂ (fig. 22) and ♀ (fig. 30) hind wings; in the ♂, the M2 marginal tooth is obsolete, and in the ♀, there is no well defined M3 tooth. All veins marked on the hind wing by long, raised scales,

The color pattern is shown in fig. 30, and gives the impression of being simpler than *C.* sp. near *suffusa*. Labial palpi ×2.1–3.2 eye width.

♂ *genitalia*: A8 tergite and sternite short, not enclosing the genitalia; the apical 1/4–1/3 of the valvae and coremata projecting beyond the 8th segment; corematal scales straw colored, conspicuous. Octavals obsolete, short.

The saccus is broader than in the previous species, the labides are sparsely setose, the costal process—annellus fusion area is smooth and weakly setose; the 4 aedeagal cornuti have irregular bases and the aedeagus width is approximately 1/3 its length. Valvae, coremata do not consistently differ from the previous species.

♀ *genitalia*: Ovipositor lobes stout, squared, with 8–10 very long setae and many very short setae, especially ventrally. Ostiolar lamellae as figured, moderately sclerotised. Ductus bursae short, broad, with no ventral scobinate flange; the dorsal appendage with an apical prolongation bearing 2 short spines. No signum. Corpus bursae globose.

MATERIAL EXAMINED. Holotype ♂: Tucker Cove, ex malaise trap, 16–18. XII. 1961, Gressitt; allotype ♀: same locality, 18–21. XII. 1961, Gressitt; 1♀, Campbell I., 1943, J. H. Sorensen; 1♀, *ditto*, 11. IX. 1947, Sorensen (WDM); 27♂♂, 51♀♀, Tucker Cove, ex malaise trap, 21. XI–23. XII. 1961, Gressitt; 1♂, Beeman Camp, 9. XII. 1961, Gressitt; 1♀, *ibid.*, 20. V. 1962; 1♀, *ibid.*, 29. IX. 1962, K. A. J. Wise (BISHOP).

DISTRIBUTION: Campbell I.

There were sufficient data from one locality over one season (1961) to show flight-season differences between the two *Chloroclystis* species. From 22 Nov. to 30 Nov. 20 *C. impudicis* and 7 *C.* sp. near *suffusa* were collected in a malaise trap at Tucker Cove, from 1 Dec. to 8 Dec., 45 *C. impudicis* and 2 *C.* sp. near *suffusa* were collected. From 16 Dec. to 23 Dec., 30 *C. impudicis* and 2 *C.* sp. near *suffusa* were collected. The 2 species thus appear to have overlapping flight seasons, and their peak periods are close together. Other aspects of *C. impudicis* and the preceding species have been discussed in the introduction. *C. impudicis* is derived from the Auckland I. population and reduction and simplification of genitalic structures have taken place in both sexes. No intermediate forms between these 2 species were found, so it can be assumed that they do not readily interbreed. As mentioned earlier, there is scope for work on the biology of these sibling species. This species is unique among the New Zealand *Chloroclystis* in the uncovered ♂ genitalia, hence its specific name. It is immediately distinguished in the ♂ from *C. aristias* by its lack of pectinations on the antennae. (There is no type ♀ of *C. aristias*.)

KEY TO GEOMETRID LARVAE COLLECTED BY BISHOP MUSEUM EXPEDITION 1961–63

The following key does not attempt to fix the identity of the *Xanthorrhoe* and *Chloroclystis* larvae, but is merely a convenient starting point for any future work on the subantarctic geometrids.

1. Seta SV2 absent on A1; anal shield rounded, with seta SD1 more anterior to D1 than SD2 is posterior to D1; body cuticle smooth; ocelli without a marginal dark sclerotised ring ..... **Epiphryne charidema**

   Seta SV2 present on A1; anal shield, if rounded, with SD1 posterior to D1, and body cuticle scobinate..... 2

2. Anal shield rounded, shorter than wide, and with SD1 posterior to D1; cuticle scobinate (scobinations of minute flat plates); paraprocts conspicuous, projecting beyond anal shield ..... **Chloroclystis** spp.
   Anal shield of variable shape but SD1 anterior to or on a line with D1; body cuticle usually heavily pigmented but not scobinate as above; paraprocts not conspicuous 3
3. Anal shield with a ventral median pallid projection; with 4 pairs of marginal anal shield setae ..... **Hydriomena similata**
   Anal shield without such a projection; with 3 pairs of marginal anal shield setae 4
4. Abdominal spiracles thickrimmed, small; anal shield with SD and D1 in line transversely; all shield setae on apical 1/3 ..... **Xanthorrhoe** sp. A.
   Abdominal spiracles thinrimmed, large; anal shield with SD not in line with D1; setae not concentrated on apical 1/3 ..... **Xanthorrhoe** sp. B.

I wish to thank Dr. J. L. Gressitt, Bishop Museum, Honolulu, and Dr. S. D. Richardson, Forest Research Institute, for permission to do this work; Mr. D. S. Fletcher, British Museum (Natural History), London, for advice, and for specimens and preparations which he so willingly provided; Dr. R. A. Falla, of the Dominion Museum, for permission to use Cape Expedition and Hudson material, and Mr. R. G. Ordish of the same Museum for his cheerful cooperation in sorting and sending the material within such a short period.

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