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Notes on the Taxonomy of the New Zealand Glow-worm, *Arachnocampa luminosa* (Skuse). (Dipt: Mycetophilidae)

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Abstract

THE name of the New Zealand glow-worm is reaffirmed as *Arachnocampa luminosa* (Skuse). It is placed in the subfamily Ceroplatinae mainly on the basis of larval characters. A description of all stages of the insect is given and all locality data are recorded. One species of the genus *Arachnocampa* is known from New Zealand.

INTRODUCTION

A summary of the investigations on the New Zealand glow-worm up to 1946 was made by Hudson (1950). The insect seems to have been regarded as a difficult insect both biologically and taxonomically. Most early workers were hindered by a shortage of material, a situation which need never have occurred, because the insect is very common throughout New Zealand. Only recently has a complete and accurate description of its life history and general biology been published (Richards, 1960). Other recent papers on the biology (Gatenby 1959, 1960) have tended to add to the confusion of the early work by recording erroneous facts. These points have been discussed by Richards (*loc. cit.*).

Confusion has also recently been introduced into accounts of the taxonomy of the fly. Originally the insect was described as *Bolitophila luminosa* by Skuse (1890). Edwards (1924) following sound taxonomic procedures created a new genus *Arachnocampa* for this species. This designation had not been queried until Gatenby (1959) referred the insect back to the genus *Bolitophila.* The reasons given by Gatenby for this reversion to *Bolitophila* are: "there appears no good reason for basing the classification of the glow-worm on its larval characters, by which Edwards must have meant the externals of the head. Hudson disliked such a classification based on the characters of a larva with peculiar habits, and was not satisfied with the erection of a new genus *Arachnocampa**; he preferred Skuse's original term *Bolitophila,* based on wing venation which is usual. In standard books . . . such as those of Imms, Harvey, Tillyard and Wigglesworth, the name

* Hudson does not appear to state this in any of this work.

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is *Bolitophila luminosa*, and it is felt that this usage should be followed." Again Gatenby (1960) justified his use of *Bolitophila* by: "The scientific name of this insect is *Bolitophila luminosa*. Some years ago the name was changed, I think, on unsatisfactory grounds to *Arachnocampa luminosa*—so let us call it *B. luminosa*."

Further confusion seems to have been introduced unwittingly by Gatenby (1959) in retaining *Arachnocampa* as an alternate name to *Bolitophila*, by bracketing the name in the position reserved in taxonomy for the name of a subgenus.

By using the name *Bolitophila* Gatenby failed to appreciate the previous work on the taxonomy of the glow-worm. All taxonomic arguments about the fly had been at the subfamily level and not at the generic level. Nobody had yet suggested that *Arachnocampa* was not distinct generically from *Bolitophila*. The question of interest had always been whether *Arachnocampa* belonged to the Bolitophilinae, Ceroplatinae or other subfamily.

As the New Zealand glow-worm will undoubtedly be referred to frequently in the future, it now appears desirable to have its correct taxonomic status re-affirmed.

Genus ARACHNOCAMPA Edwards

Arachnocampa Edwards, 1924. *Ann. Mag. Nat. Hist. (9) 14*: 177.

Empodia and pulvilli absent. Radial sector originates far before middle of wing and far before tip of subcosta. R_4 absent. Cross vein m-cu placed slightly beyond base of R_s.

Larval head capsule as long as broad. Labrum hood-like. Mandibles longer than broad with prominent teeth. Antennae vestigial. Posterior segment with papillae.

Pupation takes place in larval web. Pupa inactive.

TYPE SPECIES. *Arachnocampa luminosa* (Skuse).

DISTRIBUTION. New Zealand, Australia.

REMARKS. Edwards (1924) who erected the genus, did so mainly on the basis of the spider-like habits of the larvae. Although these habits were more similar to those of Ceroplatinae larvae than Bolitophilinae larvae, the adult characters, especially those of wing venation, were in keeping with Bolitophilinae and accordingly he placed *Arachnocampa* in this latter subfamily. Tonnoir and Edwards (1926) also placed it in the Bolitophilinae, but Edwards (1933) presented very full data on the structure and habits of the larvae and concluded from this data that the genus was close to *Ceroplatus* (subfamily Ceroplatinae) and was only very distantly related to *Bolitophila*.

The separation of Mycetophilidae into subfamilies is not easy. Early workers were satisfied to distinguish the Bolitophilinae primarily by the presence of the cross vein r-m. The Ceroplatinae were those which lacked this cross vein and had the radius and media fused. Using this criterion, the New Zealand glow-worm was legitimately placed in the Bolitophilinae.

Recent workers, however—e.g., Shaw and Fisher (1952) have recognised that the character of the r-m cross vein should be interpreted more broadly. Its relative position as regards the m-cu cross vein is now considered to be more important than its presence or absence. Indeed, this cross vein is present in the Diadocidinae and present in one genus of the Ceroplatinae. These facts make it all the more important to consider other taxonomic characters in the Mycetophilidae. This has been done by Edwards in the case of the New Zealand glow-worm when he made use of larval characters in discussing the systematic position of the insect.

The morphological characters of *Arachnocampa* especially those of the larvae show that this genus should be regarded as belonging to the Ceroplatinae rather than the Bolitophilinae.

The genus *Arachnocampa* was erected originally for one species—*A. luminosa*. Only one further species has been added to the genus: *A. tasmaniensis* Ferguson, 1925. This is an Australian species and although the type and allotype have been examined, no conclusion has been reached as to the relationship between the two species. The adults of the two species appear to correspond entirely. A good series of adults and immature forms is needed for a re-examination of *A. tasmaniensis*, and these are not yet available.

ARACHNOCAMPA LUMINOSA (Skuse)

Bolitophila luminosa Skuse, 1891. *Trans. N.Z. Inst. 23*: 48.

Arachnocampa luminosa (Skuse), Edwards, 1924. *Ann. Mag. Nat. Hist. (9), 14*: 175.

ADULTS. Male and female (Figs. 1 and 2). Body length 9–15 mm in males; 10–16 mm in females. Wing length, 6–8.5 mm in males, 7.5–12 mm in females.

HEAD. Antenna brown, scape and base of first flagellar segment light brown. Basal segment of scape with tuft of black hairs at distal portion of ventral and dorsal surfaces; second segment with small black hairs at apex of ventral surface and occasionally a minute hair mid-dorsally. Flagellum uniformly covered with matt of short hairs. Diameter of segments of scape approximately 1.5 times diameter of first flagellar segment. The 14 flagellar segments successively narrowed to small pointed apical segment. Front dark reddish-brown, with raised ridge extending from dorsal corner of eye to anterior of front between antennal fossae and leaving an anterior median cleft. Vertex and occiput black, bearing black hairs. Ocelli distinctly raised above level of vertex. Face pale yellow or light brown with fine black hairs ventrally. Palpi yellowish-brown, basal segment often darker brown; basal segment approximately equal in length to second segment and stouter than it; third segment at least twice length of second and clubbed shaped towards apex. Few fine hairs on palpi; more pronounced in female. Male palpi more slender than female. Proboscis small. Eyes black or dark reddish-black in pinned specimens and covered with distinct matt of hairs.

THORAX. Mesonotum yellowish-brown with large blackish-brown or blackish-red areas; the major one a broad band on posterior two-thirds of mesonotum lateral to dorsocentral, a circular darker area in supraalar region and between dorsocentrals a lighter area extending to anterior margin of mesonotum fading out at about posterior quarter of mesonotum and often distinctly lighter even to yellowish-brown on mid-longitudinal line. Scutellum dark brown or blackish-brown with yellowish-brown areas laterally. Postscutellum brown or dark brown with yellowish-brown lateral margins. Pleurites mostly dark brown or blackish-brown with light brown margins. Strong black hairs on dark brown supraalar region and on postalar region; scutellum with fine marginal hairs; postscutellum bare; propleuron with small cluster of hairs; metapleuron with fine hairs over most of its surface; other pleurites bare.

LEGS. Coxae pale yellow, distal margin brown; mid and hind coxae also with brown area over lateral and posterior surfaces of distal sixth and third respectively. Trochanters dark brown distally. All femora light yellowish-brown with dark brown apical areas especially dorsally and more pronounced and extensive on mid and hind femora. Tibiae light brown or brown; fore tibiae with one antero-ventral apical; mid and hind tibiae with a pair of ventral apicals. Tarsi brown.

Wings shining clear; apical two-fifths uniformly shaded a light brown. Veins dark brown, apex of subcosta either normal and meeting costa (Fig. 4) or vein weak or absent at this point (Fig. 3). Base of M_1 often weakened in its curve to join M_2.

Halteres with light yellow stem, dark brown capitellum.

ABDOMEN. All segments dark brown merging to yellow on anterior margin, sternites lighter than tergites.

External male genitalia (Figs. 8 and 9). Clasper about three times as long as broad, approximately cylindrical and with a blunt, heavily chitinized apical portion. Claspers normally strongly convergent and acutely angled on last abdominal segment. External female genitalia (Fig. 7). Papillae three segmented; all approximately equal length and evenly haired over all surfaces. Slightly or strongly divergent.

PUPA. Length 10–14 mm in male and 12.0–17.5 mm in female. Male pupae with the distinctly convergent claspers visible and female pupae with the distinctly divergent papillae visible.

LARVA. Length 3–5 mm when newly hatched; 30–40 mm when fully mature. Width of fully grown larva 1.0–1.5 mm. Colour generally creamy white, head brown.

Head: Well chitinized, bent ventrally. Labrum with pair of distinct comb-like plates at anterior extremity of a narrow band of chitin which arises from anterior margin of chitinized portion of labrum. Each comb with about 10 long teeth equal to the length of the comb. Mandibles (Fig. 5) with two strong and two weak teeth on apical margin and one tooth on inner surface at about apical third. Maxilla (Fig. 6) with approximately 10 distinct teeth in row along outer margin. Antenna vestigial and in form of low hemispherical protuberance. Large sensory area ventral and a smaller sensory area posterior to antennae. Pair of small papillae at caudal end.

EGG. Spherical. Pale yellow, changing to rouge just before hatch. Diameter 0.75 mm.

HOLOTYPE. Wellington (G. V. Hudson coll.). In the collections of the Australian Museum, Sydney.

MATERIAL EXAMINED

ADULTS. Waipu: Waipu Caves, 50 yards in, 12/9/1959, 2 ♂; 150 yards in, 25/10/1959, 1 ♂, 1 ♀ (*B. M. May*): Caves, 26/9/1959, 1 ♀; pupae collected 26/9/1959, adults emerged 28/9/1959, 2 ♀, 30/9/1959, 2 ♀, 2/10/1959, 1 ♀, 5/10/1959, 1 ♂, 7/10/1959, 1 ♀ (*A. M. Richards*). Waitakere Ranges: Swanson, waterworks tunnel, caught on wing, 23/9/1956, 1 ♂, 2 ♀ (*R. W. Taylor*); Swanson, waterworks tunnel, bred ex pupae, 30/6/1959, 8 ♂, 8 ♀, (*A. M. Richards* and *R. A. Harrison*); Swanson, waterworks tunnel, 14/2/1960, 1 ♂, 1 ♀ (*in cop.*), (*A. M. Richards*); Titirangi, waterworks tunnel, 18/10/1959, 1 ♀, 1 ex.; emerged 23/10/1959, 1 ♀, (*A. M. Richards*). Port Waikato: Puriri Caves, 1/8/1959, 1 ♀ bred ex pupa (*B. M. May*). Matira: Gaskells Cave, 50 yards in, 14/9/1958, 2 ♂, taken *in cop.* on ♀ pupal exuviae (*B. M. May*). Te Awamutu: Karamu Cave, emerged ex pupa 17/8/1957, 1 ♀ (*B. M. May*). Te Kuiti: Waipuna Cave, emerged ex pupa, 2/2/1957, 1 ♂ (*B. M. May*); Hollow Hill Cave, 9/8/1958, 1 ♂ (*B. M. May*). Waitomo: Bred from larva, 1 ♀, 1926 (*A. Tonnoir*) (*Auck. Mus.*); glow-worm Cave, Demonstration chamber, 3/11/1954, 2 ♀; 11/6/1955, 1 ♂, 1 ♀; 22/6/1956, 1 ♂, 1 ♀; 15/7/1959, 8 ♂ 1 ♀; 16/7/1959, 1 ♀ (*A. M. Richards*); Bush near Aranui Cave, bred ex pupa collected 14/7/1959, emerged 16/7/1959, 1 ♀ (*S. A. Rumsey*); Gardners cut, 25/10/1959, 1 ex. (*D. Smith*). Wellington: Botanical Gardens, bred from larva collected 4/4/1889, 1 ex.; pupae collected 24/4/1926; 1 ♀ emerged 13/9/1926; 1 ♂ emerged 4/11/1926 (*G. V. Hudson*) (*Dom. Mus.* Wellington). Nelson: Aniseed Valley, 17/1/1956, 1 ex (*E. S. Gourlay*) (Ent. Div. Nelson).

PUPAE. Waipu: Waipu Caves, 26/9/1959, 2 ♂, 2 ♀ (*A. M. Richards*). Waitakere Ranges: Swanson, waterworks tunnel, 30/6/1959, 2 ♀ (*A. M. Richards* and *R. A. Harrison*); Titirangi, waterworks tunnel, 18/10/1959, 1 ♂ (*A. M. Richards*). Waitomo: Waitomo Cave, 8/6/1955, 1 ♀; 15-16/7/1959, 1 ♂, 4 ♀ (*A. M. Richards*).

LARVAE. Waipu: Waipu Cave, 26/9/1959, 7 ex. (*A. M. Richards*); 25/10/1959, 1 ex. (*B. M. May*). Waitakere Ranges: Swanson, waterworks tunnel, 30/6/1959, 6 ex.; 6/7/1959, 1 ex. (*A. M. Richards*); 30/6/1959, 6 ex. (*A. M. Richards* and *R. A. Harrison*). Te Kuiti: Waipuna Cave, 11/1/1958, 5 ex. (*K. A. J. Wise*). Waitomo: Glow-worm Cave, Grotto, 16/7/1959, 7 ex.; 18/9/1959, 12 ex. (*A. M. Richards*); White's Cave, 25/10/1959, 50 ex.

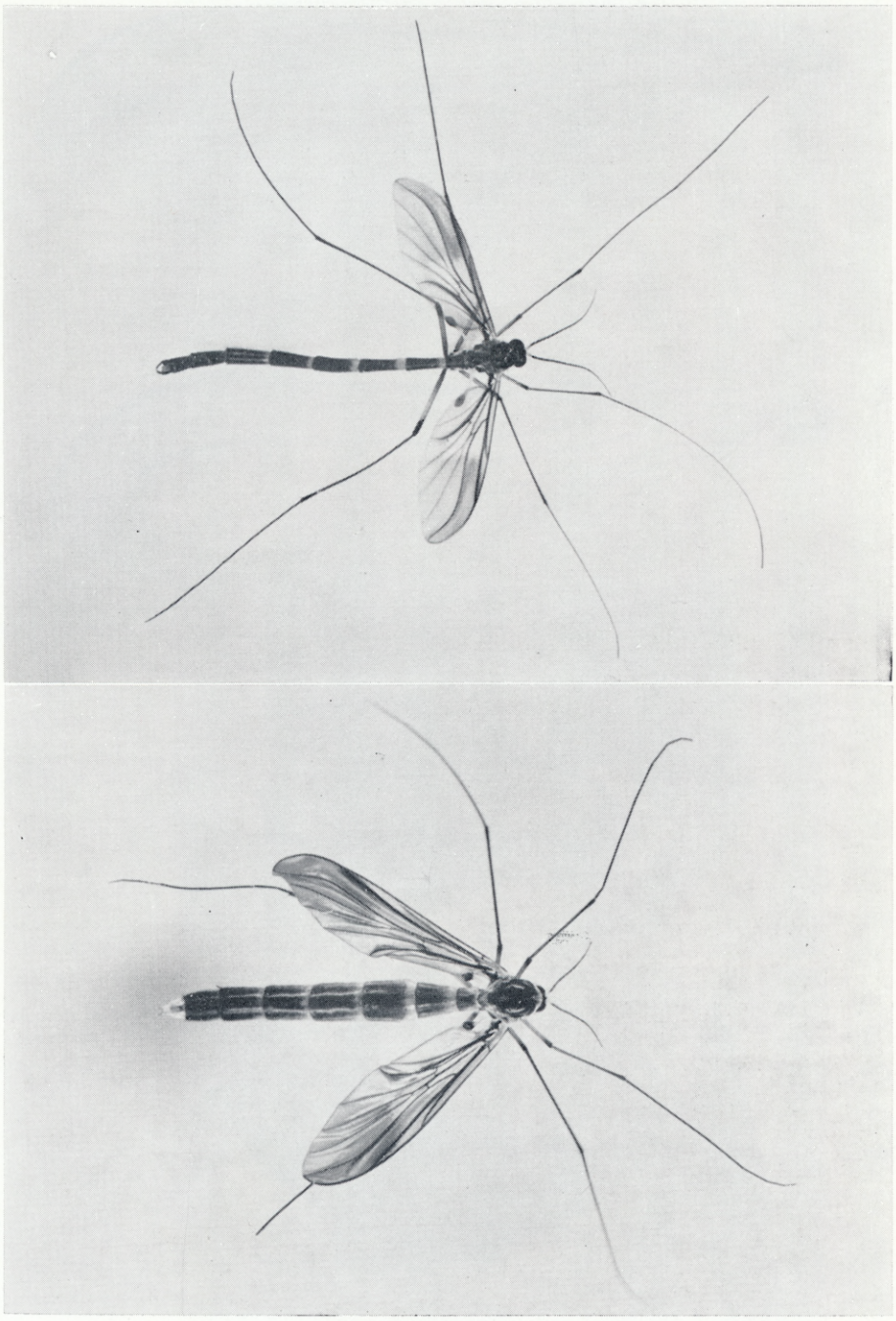
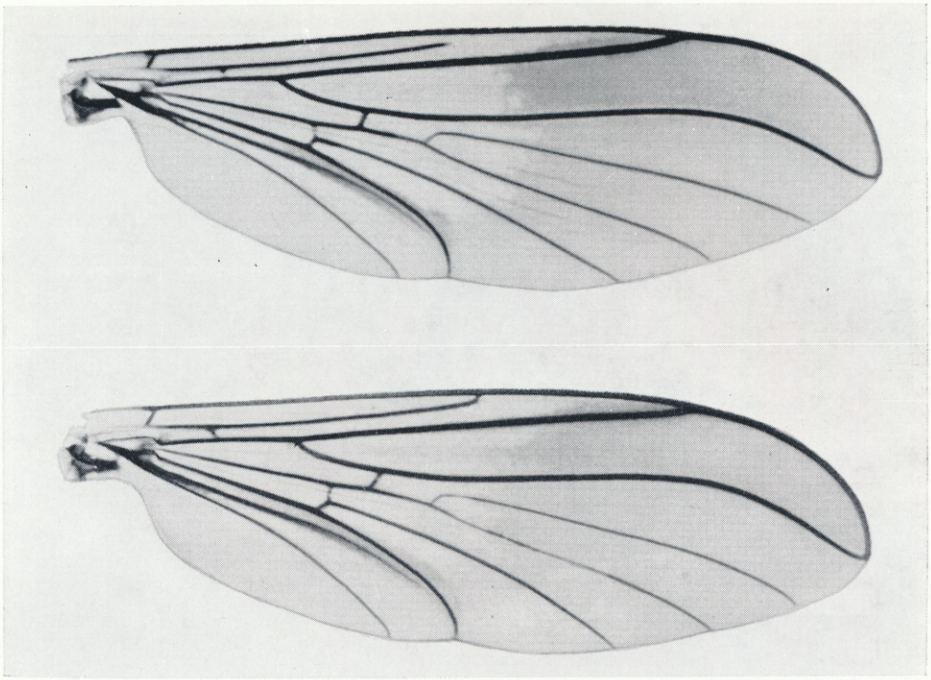


FIG. 1.—Adult ♂ *Arachnocampa luminosa* (× 4).
FIG. 2.—Adult ♀ *Arachnocampa luminosa* (× 4).

Photos by S. A. Rumsey.



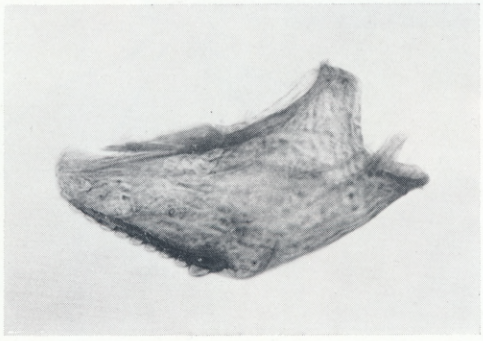


FIG. 3.—Wing (Waitomo specimen) *Arachnocampa luminosa* (× 12).
FIG. 4.—Wing (Waitakere specimen) *Arachnocampa luminosa* (× 12).
FIG. 5.—Mandible of larva of *Arachnocampa luminosa* (× 150).
FIG. 6.—Maxilla of larva of *Arachnocampa luminosa* (× 150).

Photos by S. A. Rumsey.

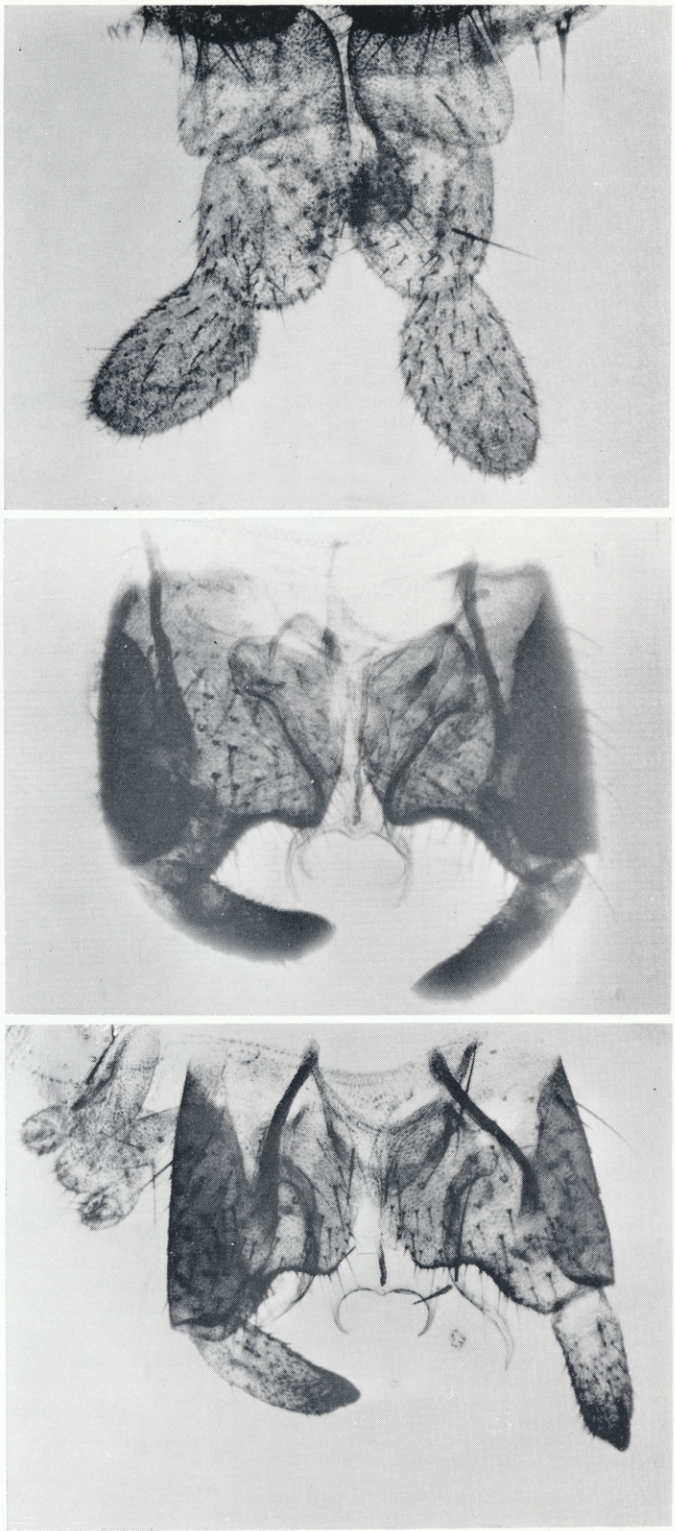


FIG. 7.—External ♀ genitalia of *Arachnocampa luminosa* (× 50).
FIGS. 8 and 9.—External ♂ genitalia of *Arachnocampa luminosa* (× 50).
Photos by S. A. Rumsey.

(*D. Smith*). Nelson: Stoke, roading tunnel, 27/1/1960, 20 ex. (*E. S. Gourlay*). Te Anau: Te Ana-au Cave, 3/1/1958, 4 ex. (*I. Pybus*).

Unless otherwise stated, all specimens are in the collections of the Plant Diseases Division, Department of Scientific and Industrial Research, Auckland, New Zealand.

REMARKS. This species is widespread throughout New Zealand and occurs naturally not only in caves and tunnels but also in the forest. One difference observed between the various populations has been that of size. Richards (1960) gives the appropriate measurements of both body length and wing length for both sexes of a cave population and a non cave population. The larger size of the cave population is suggested by Richards (*loc. cit.*) as being due to the greater food supply available to larvae in caves.

The only other morphological difference observed in the various populations concerns the subcosta. In the Waitomo population the subcosta usually ends free of the costa (Fig. 3) whereas in the Waitakere, Waipu, Nelson and Aranui bush populations the subcosta is usually complete and ends strongly in the costa (Fig. 4). None of the populations has the subcostal character consistent in all its members, and the variations are considered to be infraspecific only.

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