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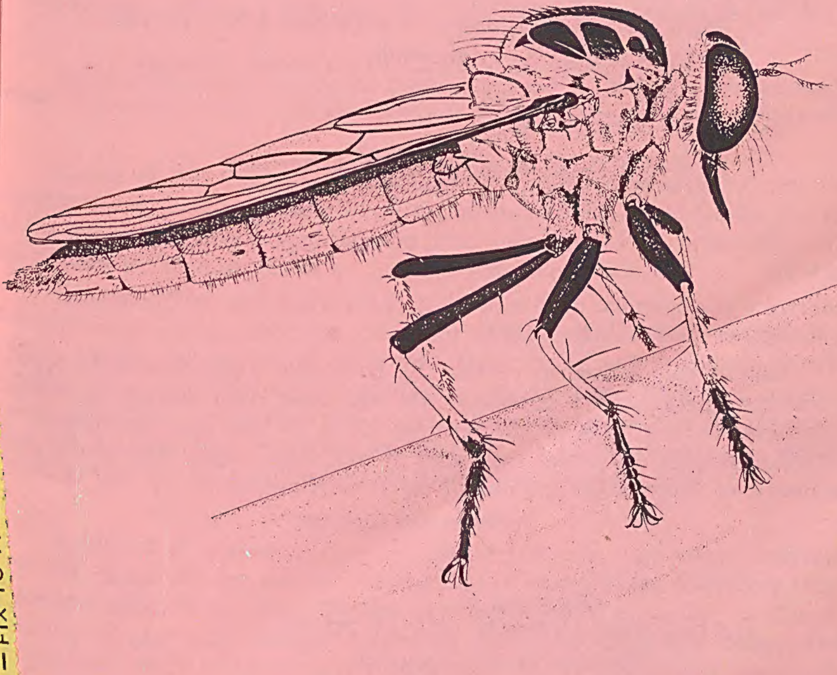

Edited by M. S. Moulds

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COVER

Illustrated by Greg Daniels.

Depicts the Australian robber fly, *Ommatius angustiventris* Macquart a common species found throughout the east coast from central Queensland to eastern Victoria. One of the few Australian Asilidae that has adapted to suburban gardens, its larvae are found in rich loamy soils. The adults prey on insects of many orders and usually catch them in flight.

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DEFENSIVE BEHAVIOUR OF ADULT *PTEROHELAEUS DARLINGENSIS* CARTER (COLEOPTERA: TENEBRIONIDAE)

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Abstract

Adults of *Pterohelaeus darlingensis* Carter exhibit three types of defensive behaviour: release of a secretion from eversible abdominal glands, death-feigning and stridulation.

Introduction

Larvae of the Australian tenebrionid *Pterohelaeus darlingensis* Carter are important pests in the grain-growing areas of the Darling Downs. During studies of the population dynamics of this and other false wireworms, observations on the defense mechanisms of the adult beetle have been made.

Kendall (1974) and Tschinkel (1975a) have both reviewed and expanded the knowledge of the defensive behaviour of tenebrionids. Such mechanisms centre around the release of secretions from specialized abdominal glands. Headstanding, death-feigning and stridulation are associated with such releases. Similar behaviour has also been noted in the Australian species *Adelium percatum* (F.) and *A. pustulosum* Blackburn by Eisner *et al.* (1974). However no studies of any species of the Australian tribe Helaeini have been reported.

Materials and methods

Adults of *P. darlingensis* used in the experiments were either collected from Mt. Maria (40 km east of Toowoomba) or reared in the laboratory from specimens collected as above. Beetles were subjected to a number of stimuli: pinching of legs with forceps, tapping of elytra, handling with fingers and turning onto their dorsal surface. Examination of the structure of the glands was carried out after dissection similar to that described by Tschinkel (1975b) except fresh specimens were used and the staining step omitted.

Gland secretion

When roughly handled the beetles evert two abdominal glands which allows a secretion on the inner surface to be aired (Fig. 1). Only when the beetles are roughly handled, such as when squeezed from the sides or from the dorsal and ventral surfaces, do the glands evert. Pinching of legs or tapping of the elytra normally does not cause eversion or, at the most, causes only partial eversion. Spraying of the secretion was not observed. Teneral adults require less stimulation to cause the glands to evert than do fully mature adults.

The glands consist of a pair of storage sacs lying ventrally in the abdomen on either side of the gut and genitalia and are formed by a modification of the intersegmental membrane between sternites 7 and 8. Each is about 1.5 mm long and 1.0 mm wide when full of secretion. The reservoirs are small (compared with those of other tenebrionids as figured by Tschinkel, 1975b), lightly wrinkled and roughly spherical in shape but ending in a small papilla. Thickened spiral bands as observed in some tenebrionids by Tschinkel are absent.

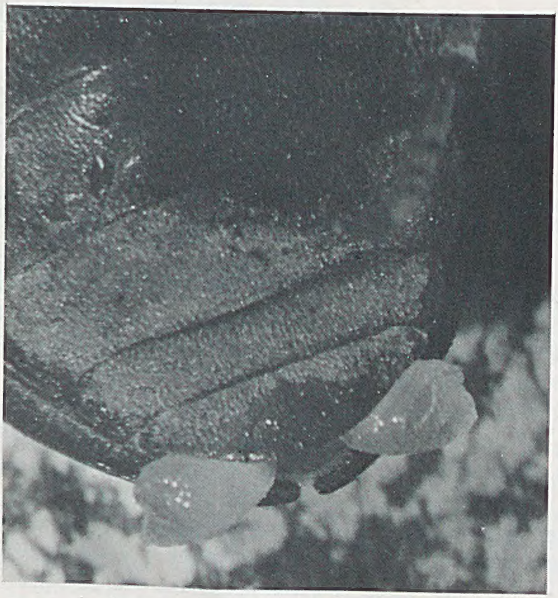

FIG. 1. Abdominal glands of *Pterohelaeus darlingensis*.

Although the chemistry of the secretion was not investigated in depth, some observations were made. After handling beetles, fingertips were always darkly mottled. The secretion when placed on filter paper impregnated with an acidified aqueous solution of potassium iodine and starch turns the paper black. Both of these observations indicate the presence of benzoquinones in the secretion (Eisner *et al.*, 1974).

Postural behaviour

One of the two primary types of postural defensive behaviour which has evolved among the tenebrionids is the tendency to fold the legs and antennae close to the body and remain motionless (Tschinkel, 1975a). In *P. darlingensis* the posture of adults which are turned to their dorsal surfaces ranges from death-feigning with legs and antennae outstretched to the antennae being directed posteriad along the inner edge of the explanate lateral margins of the pronotum and the legs scissored shut. This leg-folding posture differs somewhat from that of most of the tenebrionids studied by Tschinkel (1975a). The legs are crossed with the tibiae touching and the tibiae and tarsi are not in contact with the body. Nevertheless in all positions the beetle remains motionless for up to five minutes after the stimulus ceases; the only movement may be an eversion of the abdominal defence glands.

Stridulation

When seized, pinched or more often when overturned *P. darlingensis* adults produce a distinctly audible sound. This is produced by movement of the hind tibiae across the edge of the explanate lateral margin of the elytra. The tibiae, in addition to being setose, also have numerous short, stout spines (Fig. 2) and the beetles push the hind legs out laterally like oars, thus scraping the spines across the elytral margins. Teneral adults show this behaviour more often than do mature individuals.

FIG. 2. Hind tibia showing spines.

Discussion

Secretion of benzoquinones from abdominal glands, death-feigning and stridulation are all considered part of the defensive behaviour of a wide range of tenebrionid beetles (Tschinkel, 1975a). In structure, the abdominal glands of *P. darlingensis* most nearly correspond to that of Tschinkel's (1975b) *Tenebrio* type. They diverge from this type in that they are spherical, terminate distally in a small papilla, and their secretion appears to be composed of benzoquinones. Additional defensive behaviour, such as death-feigning, also indicates a divergence from the *Tenebrio* type.

The death-feigning posture of *P. darlingensis* also differs from that of most other tenebrionids. It is similar to that of some species of the tenebrionid *Conibius* in that the tibiae are not in contact with the body (Tschinkel, 1975a).

Stridulation occurs in a number of species of Platynotini but in this case the strigil is located on the gular region of the head and is rubbed on a plectrum located ventrally in the prothoracic head socket (Tschinkel, 1975a). Ridges on the abdominal tergite are scraped across the elytral margin to produce sounds in *Adelium pustulosum* according to Eisner *et al.* (1974). A mechanism similar to that employed by *P. darlingensis* is found in the genus *Edrotes.* These species stridulate by rubbing the metafemora, which are finely ridged on the medial surface, over the minutely serrate epipleural ridge (Doyen, 1968).

What use are these three mechanisms in the protection of the beetles? Kendall (1974) has postulated that because the majority of tenebrionids discharge their secretion only in response to rather persistent agitation, they are only effective against enemies whose predatory behaviour involves prolonged "handling" of the prey, i.e. small insectivorous mammals and some invertebrates such as ants and spiders. Insectivorous mammals such as native and introduced *Rattus*, the introduced house mouse *Mus musculus* L., and bandicoots (Peramelidae) are likely to have evolved with or are now associated with *P. darlingensis.* Invertebrate predators found in areas populated by *P. darlingensis* include a variety of carabids, ants, spiders and the earwig *Labidura truncata* Kirby. As the invertebrates are of similar size to adult *P. darlingensis* and because the integument of the beetles is relatively tough, the beetles probably have enough time to discharge their secretion and repel the predators before sustaining serious injury. Stridulation is probably also effective against a variety of invertebrate ground predators as well as birds. As suggested by Eisner *et al.* (1974), it may also function as a warning that the beetles are protected chemically thus acting as an acoustical aposematic signal. The effect of death-feigning is to make the beetle less conspicuous. All three mechanisms therefore contribute to the protection of the species.

Acknowledgements

I wish to thank Mr H. H. Tod who allowed collecting on his property and my Ph.D. supervisors Drs A. H. Arthington and R. L. Kitching for their constructive supervision.

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TYPHLODROMUS NESBITTI WOMERSLEY REDESCRIBED (ACARI: PHYTOSEIIDAE)

By E. Schicha

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Abstract

The male of *Typhlodromus nesbitti* from New South Wales, Australia, is described and illustrated for the first time. The female is redescribed.

Introduction

Males and females of *Typhlodromus nesbitti* Womersley were found in large numbers on the bark of apple trees in neglected orchards and on neglected backyard trees during the years 1971 to 1974 at Bathurst, N.S.W. The species was also found occasionally on bark and leaves of Granny Smith apple trees in experimental orchards at Bathurst, where it was observed feeding on eriophyid and tydeid mites. The early stages remain unknown as attempts to breed the species were unsuccessful.

Womersley (1954) described the female of this species. Chant (1959) summarised Womersley's description without including additional features. In the present paper both sexes are dealt with in detail.

Genus *Typhlodromus* Scheuten

Typhlodromus Scheuten, 1857, *Arch. Naturgesch. 23: 111. Type species T. pyri* Scheuten, 1857.

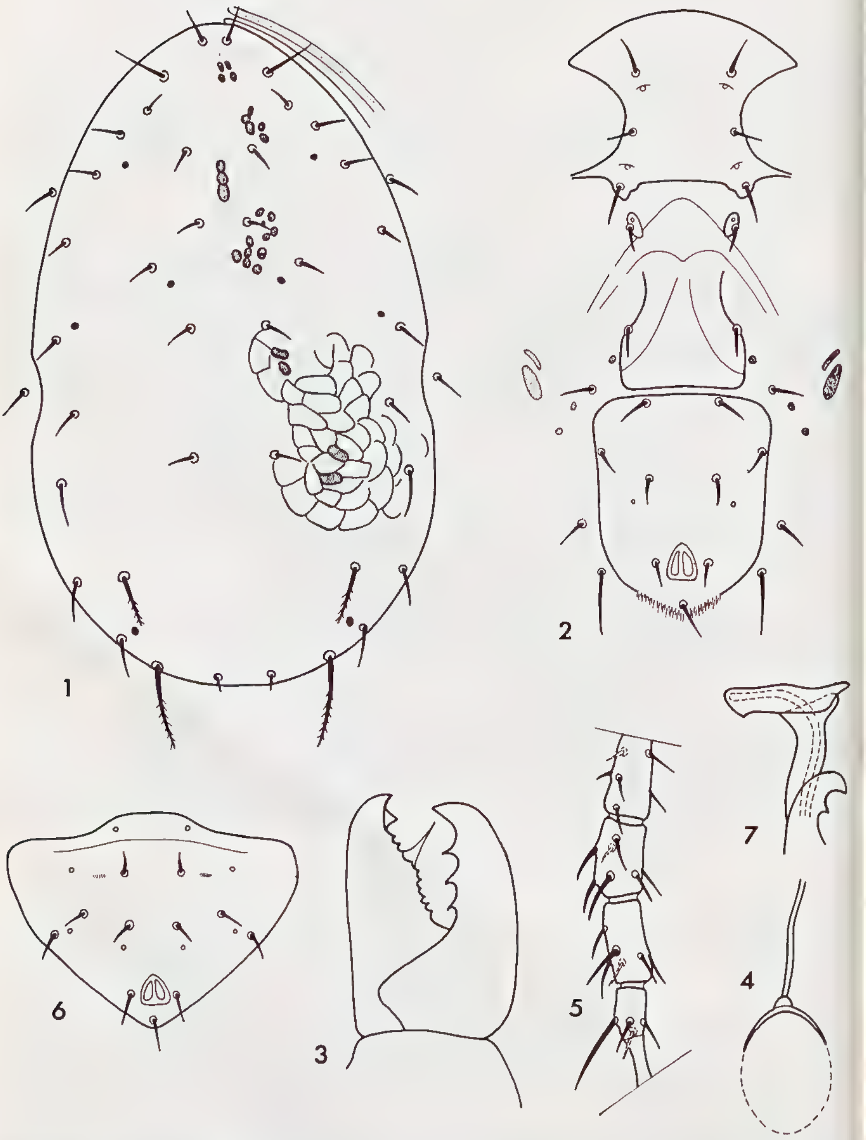
Typhlodromus nesbitti Womersley (Figs 1-7)

Material examined. NEW SOUTH WALES: one ♀ labelled *Typhlodromus nesbitti* Womersley, from galls on tree lucerne, Goulburn, 7.vi.1934, in South Australian Museum, Adelaide (*holotype*). Twenty ♀♀ (T.ne. 1-20), and 6 ♂♂ (T.ne. 21-26), from bark of neglected apple tree, Bathurst, 21.iii.1972, E. Schicha, in Biological and Chemical Research Institute, Rydalmere.

FEMALE

Measurements are the mean and standard deviation of 20 specimens in micrometres. Womersley's measurements are given in brackets.

Dorsum. Imbricated dorsal shield 395 ± 8 long, 236 ± 10 wide at L4, with 19 pairs of setae, six dorsal, two median, eleven lateral: D1 22 ± 3 (28) long, D2 14 ± 1 (17), D3 14 ± 1 (17), D4 16 ± 1 (17), D5 17 ± 1 (20), D6 11 ± 1 (11), M1 15 ± 1 (17), M2 34 ± 3 (36), L1 24 ± 3 (20), L2 13 ± 2 (20), L3 22 ± 3 (22), L4 21 ± 2 (22), L5 23 ± 2 (25), L6 22 ± 2 (25), L7 18 ± 1 (20), L8 27 ± 2 (28), L9 22 ± 2 (22), L10 21 ± 1 (22), L11 58 ± 2 (56). M2 and L11 serrated, all other setae smooth. L1 longer than distance between its base and base of L2. L2 and L10 as long as, all other setae shorter than, distances between their bases and bases of setae following next in series. Four pairs of large pores. S1 and S2 16 ± 1 (20), on interscutal membrane. Peritreme extending forward to base of D1 (Fig. 1).



FIGS 1-7. *Typhlodromus nesbitti* Womersley: (1) ♀ dorsum; (2) ♀ sternal, genital and ventrianal shield; (3) ♀ chelicera; (4) ♀ spermatheca; (5) ♀ leg IV; (6) ♂ ventrianal shield; (7) ♂ spermatodactyl.

Venter. Smooth sternal shield 97 ± 4 long, 115 ± 6 wide, with three pairs of setae and two pairs of pores near first and third pair of setae. Fourth pair of sternal setae on oval shields bearing anteriorly a pore each. Genital shield 80 ± 2 wide, normal with pair of setae and straight posterior margin. Smooth pentagonal ventrianal shield 132 ± 4 (143) long, 113 ± 4 (110) wide, with three pairs of preanal setae and pair of preanal pores 61 ± 2 apart (Fig. 2).

Chelicera. Fixed digit 45 ± 2 long, with strong subapical tooth in addition to a series of 10 small teeth plus pilus dentilis. Movable digit 51 ± 3 long, with three large subapical teeth, the posterior two pointing backwards (Fig. 3).

Spermatheca. Bowl-shaped (Fig. 4).

Legs. Macroseta on basitarsus IV 43 ± 1 long (Fig. 5).

MALE

Dimensions listed are the range of three specimens in micrometres.

Dorsum. Imbricated dorsal shield 294-303 long, 159-167 wide at L4. Chaetotaxy of shield resembling that of female: D1 16-22 long, D2 13-14, D3 10-14, D4 13-14, D5 14-15, D6 8-11, M1 11-13, M2 29-31, L1 25-29, L2 12-15, L3 19-21, L4 17-21, L5 20-23, L6 18-20, L7 14-18, L8 21-24, L9 18-19, L10 18-20, L11 43-48, S1 and S2 17-19.

Venter. Ventrianal shield 130-132 long, 169-173 wide, with four pairs of preanal setae and three pairs of pores in addition to a pair of small preanal pores 43-45 apart (Fig. 6).

Spermatodactyl. With terminal heel, lateral process of foot (length 14-16) sharp. Toe rounded, with small tooth posteriorly (Fig. 7).

Legs. Macroseta on basitarsus IV 33-36 long.

Notes

The following observations were not made by Womersley (1954): idiosoma of female imbricated; M2 and L11 serrated; four pairs of large pores on dorsal shield. The holotype as well as slides T.ne.1 and T.ne.21 have been examined by Dr H. A. Denmark, Florida Department of Agriculture, Gainesville (U.S.A.) in 1974. The holotype has also been examined by Dr B. A. Wainstein, Borok, Nekouz, Jaroslavl (U.S.S.R.) in 1976. Both workers identified the respective specimens as *T. nesbitti.*

Acknowledgements

I am greatly indebted to Dr H. A. Denmark, Florida Department of Agriculture, Gainesville (U.S.A.) for assistance in the initial stages of this paper.

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NEW DISTRIBUTION RECORDS FOR QUEENSLAND BUTTERFLIES

By John Olive
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Collecting by the author in northern and south-eastern Queensland has resulted in the following interesting distribution records. All specimens mentioned are in the author's collection.

HESPERIIDAE

Trapezites iacchus (Fabricius). Three specimens were taken in July, 1972 on Hayman Island, Whitsunday Passage. While this locality is within the known range of this species it is interesting to note that the butterfly occurs on off-shore islands.

Sabera fuliginosa fuliginosa (Miskin). Six males taken during early April 1974 at Malanda Falls, Atherton Tableland. Specimens have been taken at Rumula (west of Mossman) and Kuranda, but not from the Tableland (Common and Waterhouse, 1972).

NYMPHALIDAE

Euploea darchia niveata (Butler). A single male, flying in company with *E.tulliolus tulliolus* (Fabricius), was taken on 4 Jan. 1977 at Caloundra, south-east Queensland. Previously this species has not been recorded south of Mackay (c.f. Common and Waterhouse, 1972).

Mycalesis terminus terminus (Fabricius). One specimen taken in early Jan. 1977 at Bingera Weir, near Bundaberg. Previously the species had been taken as far south as the Kolan R., 48 km north of Gin Gin (Common and Waterhouse, 1972).

Yoma sabina parva (Butler). A single slightly ragged specimen was taken 8 April 1974 at Malanda Falls, Atherton Tableland. While Cairns remains the southern known limit for the range of this butterfly this record confirms its presence on the Tableland.

LYCAENIDAE

Candalides helenita helenita (Semper). Two females taken during early April 1974 at Malanda Falls, Atherton Tableland. This butterfly is known from Kuranda but does not appear to have been previously recorded from the Tableland.

Candalides acastus (Cox). A pair taken in Jan. 1977 at Burrum Heads, (between Maryborough and Bundaberg). Maryborough was the previous known northern limit for this species.

Nesolycaena albosericea (Miskin). Ten males and one female were taken on 9 Jan. 1977 at Burrum Heads. Several others were seen at the time. On returning to the same locality three days later not one specimen could be found. This uncommon butterfly is known from comparatively few localities. Common and Waterhouse (1972) record it from only Expedition Range, Eidsvold, the Carnarvon Range and Stradbroke Is. while Atkins (1976) adds Isla Gorge, central Queensland.

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NOTE ON THE HABITAT OF THE PRESUMED LARVA OF *AUSTRONEURORTHUS* (NEUROPTERA, NEURORTHIDAE)

By T. R. New
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An Australian neurorthid larva was described by Riek (1970) from a specimen found in moist litter. This larva, tentatively identified as that of *Austroneurorthus* sp., was later found to be closely similar to the aquatic larva of the European *Neurorthus fallax* (Rambur) described by Zwick (1967) (Riek, 1974). Nothing further has been published on the habitat or relationships of the Australian forms.

I have recently examined several neurorthid larvae from Queensland and Victoria and the capture site of some of these leaves no doubt that the larvae are truly aquatic, and can occur in fast-flowing water. The Australian larvae are extraordinarily similar to Zwick's (1967) figures of *Neurorthus*: indeed, even positions and relative lengths of head and thoracic setae of a cleared Victorian larva correspond closely and Zwick's figures of head, thorax and their appendages could apply equally to this specimen from the Thomson River. Larval characters thus suggest an extremely close relationship between these two genera, which are separated in part because of their geographical ranges (Nakahara, 1958).

All larvae examined are large (more than 8 mm. body length) and, although these are clearly aquatic, nothing is known of the oviposition site of the adults or of the larval feeding habits.

RECORDS OF NEURORTHUS LARVAE

QUEENSLAND. 1 ex., Tinaroo Dam, 2 km on Mt. Edith Rd, 23 June 1971. E. F. Riek; 1 ex., Bunya Mts., Big Falls, 3300 ft, 4 July 1971, E. F. Riek (both in Australian National Insect Collection (ANIC)).

VICTORIA. 3 ex., U. Yarra River, McMahon's Creek, 1 October 1972 (ANIC); 1 ex., Upper Thomson River, Park Rd., (kick sample from large pebbles, small cobbles, some sandy patches under cobbles), 25 November 1976, J. D. Blyth; 3 ex. Ross Creek, N.E. of Jericho, 14 August 1977, J. D. Blyth (all in National Museum of Victoria).

Acknowledgements

I am very grateful to Miss J. Cardale (C.S.I.R.O., Canberra) and Mr J. D. Blyth (National Museum of Victoria, Melbourne) for allowing me to examine larvae from collections in their care.

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A RECORD OF *VAGRANS EGISTA* (LEPIDOPTERA: NYMPHALIDAE) FROM TORRES STRAIT ISLANDS, NORTHERN QUEENSLAND

By Robert Lachlan
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The butterfly *Vagrans egista* (Cramer) is widespread through the Indo-Australian region with several races being recognised. The Australian subspecies, *V. e. propinqua* (Miskin), is recorded from a relatively small area of northern Queensland; Claudie River (Iron Range), Mossman and Cairns to Ingham (Common and Waterhouse, 1972; D'Abrera, 1971; Monteith, 1972).

During a trip to the Torres Strait Islands in December 1974 and January 1975 I collected three specimens of *Vagrans egista.* A male and female were taken on Banks (Moa) Island on 31st December 1974 while they were resting a few metres apart on low vegetation at the side of a small creek near thick rain forest. A further female was taken on Thursday Island on 20th January 1975 while it was resting at the side of a dirt road that cut through a small area of rain forest on the hill behind the township.

The discovery of this species in the Torres Strait Islands thus extends its known range in Australia northwards by some 250 km.

The specimens mentioned above were compared with material of *Vagrans egista* from both Australia and New Guinea in the Australian National Insect Collection, Canberra. While a subspecific determination was not possible because of the limited number of specimens available from Banks and Thursday Islands, comparison with the Papuan subspecies *V. e. offaka* (Fruhstorfer) suggested that my Torres Strait examples were more similar to that race than to the Australian *V. e. propinqua.* The Torres Strait specimens each have five submarginal spots present instead of the two or three usually found in Queensland specimens. My specimens from Torres Strait have not been compared with the very limited material known from Iron Range.

Acknowledgements

The assistance of Mr E. D. Edwards, who kindly compared my specimens with material in the Australian National Insect Collection, is much appreciated. Mr M. S. Moulds read the manuscript and made helpful suggestions.

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MIGRATION RECORDS IN AUSTRALIA. 2. HESPERIIDAE AND PAPILIONIDAE (LEPIDOPTERA)

By C. N. Smithers
The Australian Museum, Sydney

The Hesperiidae make up a large proportion (more than 100 species) of the Australian butterfly fauna but only one has been noted as a regular migrant; the Papilionidae are represented by about 18 species of which two can probably be regarded as migrants. These two families stand in strong contrast to the Pieridae of which almost half of the 31 Australian species have been suggested or confirmed as migrants.

This note presents information on the few migrant species of Hesperiidae and Papilionidae. Similar summaries on the Pieridae and Nymphalidae are in preparation.

HESPERIIDAE

Badamia exclamationis (Fab.)

This is the only recorded Australian migrant skipper. There are several general statements in the literature which mention this species as a migrant or which refer to previous records in general terms. Despite this there are comparatively few records in which details are given.

Williams (1930) summarizes information on this species until 1929. Dodd (1933) records a northerly flight in February and a southerly flight in September-October, with speeds of 20-30 m.p.h., with counts up to 2,000/5 mins. for the northerly and smaller numbers for the southerly flight. Table I gives a summary of those records in which details of date and locality are given.

Comments. Burns (1933) provides information on larvae and life history in relation to population movements through Queensland. This, together with the data summarized in Table I shows a strong annual southerly movement with breeding in southern central and coastal Queensland followed by a northerly flight. It is clear, however, that there are considerable differences in timing and density of these flights from year to year. Similar variation is known in other migrants such as *Vanessa kershawi* McCoy (Smithers 1969). In *B. exclamationis* the southerly migration takes place over a period of a few weeks at some time from late September to early January. The northerly movements also occur over a comparatively short period and take place between mid January and the end of March. Causes of the variation in the southerly movement are unknown but the northerly movement must depend on the time of arrival from the north of the previous generation and the developmental period of the subsequent generation in Queensland as Burns (1933, p. 226) infers that the northbound specimens depart immediately after emergence. The migrations take place over a front as wide as 200 km. the specimens flying low and very fast. Large numbers of the southerly migrating generation sometimes reach Brisbane with occasional specimens occurring as far south as the Sydney area and beyond; the major migrations regularly reach the Rockhampton-Gladstone area. It is not clear how far to the north the population movements continue although Puxley (1925) suggests regular movements across the sea to and from areas north of Australia.

Table I
Summary of migration records for *Badamia exclamationis* in Queensland

Locality	Date	Direction	Reference
Brisbane	18.i - 8.ii.1923	W of S	Burns 1933
Brisbane	i.1923	NW	Upton 1949
Westwood	27.ix.1923 - i.1924	S	Burns 1933
Westwood	i.1924	SE	Upton 1949
Westwood	9-15.iii.1924	NW	Burns 1933
Meringa	xii.1926	S	Burns 1933
Meringa	1.iii.1927	-	Williams 1930
Meringa	ii.1927	N	Burns 1933
Cairns	i.1928	N	Upton 1949
Mackay	1.iii - 1.iv.1928	N	Burns 1933
Meringa	17.i.1929	N	Williams 1930
Cairns	x.1929	-	Upton 1949
Babinda	24.iii.1942	W of N	Caldwell 1963
Townsville	8-11, 28, 29.iii 1942 - 4.iv.1942	WNW	Caldwell 1963
Ingham-Tully	iii.1961	NNW	Straatman 1963
Iron Range	late x. - 2.xi.1974	SSE (30/min.)	Daniels 1975
Cairns	4.xi.1974	S (10/min.)	Daniels 1975
Westwood	9.xi.1974	S	Daniels 1975
Cairns	6.x.1966	SE	Obs. E. Corbet
Gordonvale-Cairns-Kuranda	10-20.ii.1968	N	Obs. I. Cunningham
Cairns	24.x.1968	SE	Obs. I. Cunningham
Cairns	25-30.x.1968	S	Obs. I. Corbet
Cairns	12-14.xii.1972	SE	Obs. C.N. Smithers

PAPILIONIDAE

Graphium eurypylus lycaon (C. and R. Felder)

This species has not been recorded as a migrant but was recorded as being not uncommon in the neighbourhood of Sydney (Olliff, 1888). Its appearance now in this area is, however, noteworthy. Table II gives the most recent records, which are few.

Comments. This species may be a migrant with specimens sometimes moving as far south as Sydney but detailed observations in more northerly areas are needed. Southerly records are for late January to late February.

Papilio demoleus sthenelus W. S. Macleay

As in the case of *Badamia exclamationis* this species has been confirmed as a strong migrant (Smithers and McArtney 1970; Dell 1977) but comparatively little detail has been recorded, the most detailed observations being those of Dell (*loc. cit.*) in Western Australia. Fenselau (1977) has recorded a southerly

Table II

Summary of possible migration records for *Graphium eurypylus lycaon*

Locality	Date	Reference
Sydney (Bayview)	25.ii.1970	Haines 1972
Sydney (Wahroonga)	26-27.ii.1971	Rose 1972
Sydney (Avalon Beach)	20.i.1962	Moulds 1963
Sydney (Greenwich)	24.ii.1962	Moulds 1963

movement in August at Sea Lake, Victoria. Table III summarizes other records for which adequate details are available.

Comments. This species appears to undertake somewhat sporadic migrations, the evidence for population movement often being the sudden appearance of the species in areas in which it is not usually resident.

Table III

Summary of movements and possible migrations of *Papilio demoleus sthenelus*

Locality	Date	Direction	Reference
Renner Springs, N.T.	13.v.1969	SE	C.N. Smithers and I.B. McArtney 1970
Sydney (several localities)	1-8.x.1971	sudden appearance in numbers	Rose 1972
Sydney (Ryde)	1.ii.1971	in flight with other spp.	Obs. J.V. Peters
Sydney (Cowan)	18.x.1973	seen	Obs. C.N. Smithers
Kingscliff (S. of Tweed Heads)	9.x.1976	S (50/min.)	Obs. S. Edwards
49 km N. of Singleton, N.S.W.	13-14.xi.1976	NE (10/5 hrs)	Obs. C.N. Smithers
Sea Lake, Victoria	late viii.1977	S (45 seen in three days)	Fenselau 1977

Acknowledgements

I would like to thank the several observers mentioned in this note for providing records of migration and Mr M. S. Upton for providing references to migration in Australia.

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A NEW SOUTHERN RECORD FOR *TISIPHONE HELENA* (OLLIFF) (LEPIDOPTERA: NYMPHALIDAE)

By Victor H. Jackson
80 Eyre Street, North Ward, Townsville, Qld. 4810

In a recent paper (Moulds, 1977) the known distribution of *Tisiphone helena* (Olliff) was significantly extended, principally to the north. Mission Beach (between Innisfail and Tully) has remained the known southern limit for this butterfly species. I wish to record now a new southern locality.

Over a number of years I have collected butterflies at Mt Spec, some 70 km north of Townsville, mostly around the Paluma township which is at an altitude of about 900 m. During early January of 1974, 1975, 1976 and 1977 I noted and captured several specimens of *T. helena.* I recently spent three days at Paluma from 17th to 19th November 1977 when I found *T. helena* flying in numbers. Many were feeding at flowers along the roadside and one pair was seen mating. In a series collected males outnumbered females ten to one and all specimens appeared in a fresh and undamaged condition.

The discovery of this species around Paluma extends its known range some 120 km further south. Sword grass, *Gahnia* spp, upon which the larvae of this butterfly feed, also abounds at higher altitudes south of Townsville and it is therefore likely that the butterfly will also occur there.

Reference

Moulds, M. S., 1977. Extensions to the known range of the butterfly *Tisiphone helena* (Olliff) (Lepidoptera: Nymphalidae). *Aust. ent. Mag.* 4(4): 61.

BOOK REVIEW

Bibliography of the Australian butterflies (Lepidoptera: Hesperioidea and Papilionoidea) 1773-1973 by M. S. Moulds. 239 pages listing over 2,000 references. Australian Entomological Press, Greenwich. 1977. Price $18.00.

At noon on 16th April, 1770 a small butterfly fluttered across the Tasman Sea. The recording of this incidental event by Joseph Banks on board Cook's *Endeavour* was the beginning of Australian butterfly literature. Twenty-seven butterfly species and subspecies were collected in Australia during this historic voyage, later to be described by Fabricius in 1775 in his *Systema Entomologiae.*

The growth of butterfly literature from that date was significant. Fruhstorfer, Froggatt, Felder, Hewitson, Hübner, Latreille, Miskin, Olliff and Seitz are just some of those contributors. The literature in fact had reached considerable proportions when in 1932 Anthony Musgrave compiled *Bibliography of Australian entomology, 1775-1930.* More specialized works have since been published but a detailed bibliography covering all Australian butterfly literature for present day needs has been lacking.

This latest work by Max Moulds retrieves, in unusual detail, early works both popular and rare. All literature concerning butterfly species from the Australian mainland, neighboring islands and Cocos-Keeling and Christmas Islands is included with references, bibliographical notes, publication dates and other interesting comments. Many entries give collecting dates and localities of great importance to the researcher such as those of Hermann Elgner's from the Torres Strait islands. Intriguing for instance is the listing of correspondence between G. A. Butler (1886) and W. L. Distant (1886) or the unusual records of P. Fountain (1907). Sources of obscure synonomy such as *Epinephile* (*Tisiphone*), *Hipparchioides* (*Heteronympha*) or *Cyclopides* (*Croitana*) can be found. Some workers today would be surprised to see the numerous papers published on *Liphyra brassolis* or the apparant recording of the Cabbage White butterfly from Scone in 1911.

Quite correctly, I believe, the author has deliberately retained original misspellings, thus revealing the source of several 'hand-me-down' errors of the past. From the 'Introduction' to 'List of serial abreviations with annotations' the bibliography is detailed and complete. Though the inclusion of an appendix listing all references to each of the butterfly genera was considered by the author but rejected through being impracticable, perhaps an index to each species' original description might have been useful.

'Bibliography' can suggest dust-filled, top-shelf, leather-bound volumes with bewildering rows of printed taxonomic tags. Not so this work. Moulds appears to have included in this book every reference to an Australian butterfly except the captioned tea packet swap-card and newspaper nature note. The result is a valuable, accurate bibliography treated with enthusiasm. The professional and amateur entomologist will welcome this bibliography and look forward to a supplement at a future date that includes the Australian butterfly publications since 1973.

Andrew Atkins

AN ACCUMULATIVE BIBLIOGRAPHY OF AUSTRALIAN ENTOMOLOGY

Compiled by M. S. Moulds
14 Chisholm St, Greenwich, N.S.W. 2065, Australia

This bibliography lists, in an accumulative manner, all literature published since t beginning of 1972 that directly concerns Australian insects. It attempts to fulfil the need f a comprehensive list of current Australian entomological literature. If you have published an thing likely to be overlooked I would be greatful for reprints or details of such publicatio

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Lepidoptera: *Theclinesthes onycha, Jalmenus icilius* and in the footnote of the reprint, *Theclinesthes albocincta.*
In the reprint of this issue which appeared in June 1977 (two months after the original), the above paper is titled "A new locality for the butterfly *Theclinesthes onycha* (Lycaenidae)" and has appended a footnote of some importance.

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Lepidoptera: *Hesperilla idothea, H. donnysa, Tisiphone abeona, Ogyris abrota*

The original issue of Vol. 7, part 2, in April 1977 was reprinted in June 1977 because of the partial illegibility of the original. The type-script was reset and in so doing compressed so that the reprint contains pages 8 to 16 of Vol. 7 while the original has pages numbered 8 to 21. Vol. 7, part 3, begins with p. 17.

1977. A weekend in the alpine country – March 5-6, 1977. *Victorian Ent.* 7(2): 14-21 (or pp. 13-16 in the reprint of this issue).

Lepidoptera: many butterfly species mentioned.

For note concerning the reprinting of this issue see reference above.

1977. *Pseudodipsas cuprea* in Victoria. *Victorian Ent.* 7(3): 26-29.

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WANTED. Wooden entomological cabinet, minimum 10 drawers. Any condition considered. D. Carne, 20 Belmore St, Enmore, N.S.W. 2042.

FOR SALE. *Butterflies of the Australian Region* (1st edition, 1971) by Bernard D'Abrera. As new. $50 (post free in Australia). N. McFarland, P.O. Box 475, Geraldton, W. Aust. 6530.

EXCHANGE. I would like to contact anyone interested in exchanging Australian butterflies. Please write to Mr Allen Sundholm, 2/68 Mountford Ave, Guildford, N.S.W. 2161.

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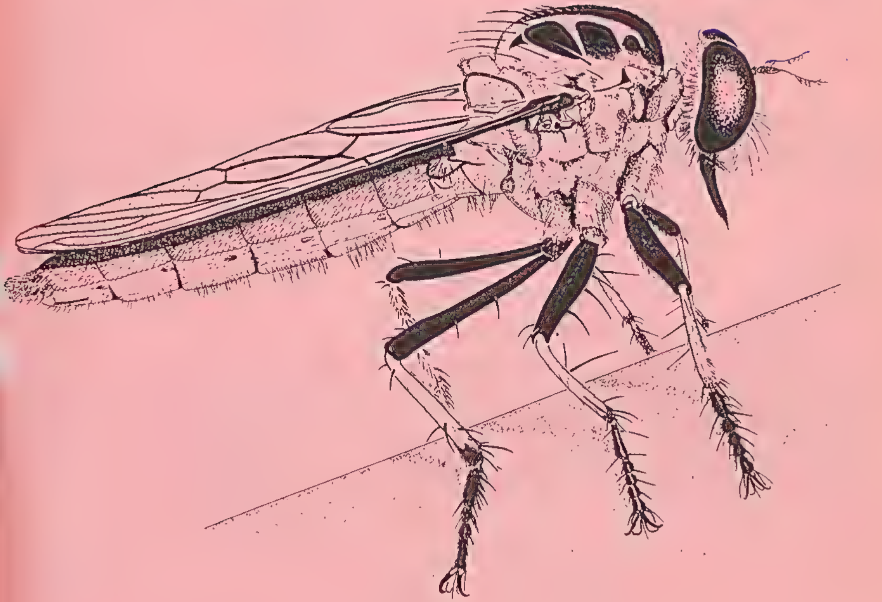

Edited by M. S. Moulds

VOLUME 5, PART 2

JULY, 1978

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COVER

Illustrated by Greg Daniels.

Depicts the Australian robber fly, *Ommatius angustiventris* Macquart, a common species found throughout the east coast from central Queensland to eastern Victoria. One of the few Australian Asilidae that has adapted to suburban gardens, its larvae are found in rich loamy soils. The adults prey on insects of many orders and usually catch them in flight.

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NOTES ON THE BIOLOGY OF *LEMIDEA SUBAENEA* (COLEOPTERA: CLERIDAE) ON *ACACIA* IN VICTORIA

By T. R. New

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Abstract

Lemidea subaenea Mulsant is univoltine: predatory adults occur from August to November, and larvae until March-April. *L. subaenea* was the most abundant clerid collected on *Acacia* spp from 1974-77. Feeding biology and life cycle are briefly outlined, and attention is drawn to a possible regular feeding association with psyllids.

Introduction

Arboreal Cleridae have been little studied in association with *Acacia*, and the only comprehensive ecological data on such relationships is limited to African species (Mateu, 1975). The twelve species studied by Mateu were predominantly associated with xylophagous prey, and this feeding habit occurs commonly in the Cleridae (Böving and Champlain, 1920; Balduf, 1935). Few other feeding associations have been reported. During surveys of insects on various species of *Acacia* in Victoria, larvae and adults of *Lemidea subaenea* Mulsant were collected each year from 1974-1977 in association with Psyllidae, and this species was the most abundant clerid found on the trees. Fragments of adult and nymphal Psyllidae were found in the foregut of several field-collected adults, and larvae have been observed feeding freely on psyllid nymphs. In captivity, both larvae and adults fed on psyllids and on other insect prey provided. *Acacia* species are exploited by a wide range of wood-boring Coleoptera, but *Lemidea* larvae have not been found inside trunks or galleries and (although they are thigmotropic and secrete themselves in bark crevices) it seems likely that their usual prey consists of free-living insects. Regularity of their occurrence on young foliage growth with Psyllidae (including *Psylla acaciaebaileyanae* Froggatt and *P. acaciaedecurrentis* Froggatt) suggests that these may be a significant prey item. This is of considerable interest in providing an unusual food record for Cleridae, and also in indicating a psyllid predator potentially useful for augmenting biocontrol of such species as *Psylla uncatoides* Seeris and Klyber.

Life cycle and habits

L. subaenea is univoltine near Melbourne. Adults are found from August to November, and are most numerous in September. They are diurnal and active, and are often to be seen on younger growth and flowering shoots of acacias. They are general predators, and cannibalism is frequent when adults are confined. Fifteen pairs kept in separate 12-dram vials without other food all resulted in one partner being eaten and, in most cases, the survivor was also mutilated. When confined with fresh *Acacia* flowers and water alone, single young adults all died within 12 days (N = 40, $\bar{x}$ 6.4 ± 1.9 days). In contrast, a similar series of young adults provided with a superabundance of psyllids aphids (*Brevicoryne*) or small *Tribolium* larvae lived for up to 45 days (N = 40 $\bar{x}$ 20.3 ± 4.7 days).

Eggs are laid singly or in small groups. They are elongate (length 1.25 ± 0.08 mm, breadth 0.38 ± 0.03 mm, N = 20) and almost smooth except for traces of reticulate areolation on the upper surface. They are pale pink when laid and turn grey during development. Hatching occurred under uncontrolled laboratory conditions in 11-15 days and young larvae were immediately active. A maximum of 47 eggs was obtained from any one female, and follicles appeared to mature after about a week of adult life.

Larvae are of the typical clerid form (Böving and Champlain, 1920 Britton, 1974) and closely resemble those of species having more cryptic habits The first instars are pale pinkish grey with head slightly darkened. The later two larval stages are darker grey, with cerci, the long thoracic and abdominal setae head and thoracic plates all black. Mean head-widths and body lengths of the three instars (N = 20 of each) are (head width) 0.30, 0.57, 0.81 mm and (body length) 1.53, 5.94, 7.92 mm.

In the laboratory, when fed on psyllids alone, larvae grew well for periods of up to 5 months, and reached a size similar to that of larvae collected in the field from February to April each year. They ceased feeding and became comatose in late summer, and secreted themselves in the cotton stoppers of the vials in which they were kept. It is likely that the winter is passed in the prepupal or pupal stage (probably under bark), but these stages have not been found in the field: all stages were absent from field samples from late April until August, and the first adults found all had small (immature) reproductive systems.

Acknowledgements

I am very grateful to Mrs J. M. Tenberge and Mrs C. Lee for much help in collecting and sorting beetles from *Acacia*. Identification of *L. subaenea* was aided by Mr A. A. Calder (National Museum of Victoria).

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A NEW SPECIES OF THE TASMANIAN CAVE CARABID GENUS *IDACARABUS* (COLEOPTERA)

By B. P. Moore
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Abstract

Idacarabus longicollis sp. n., described from Damper Cave, Precipitous Bluff, S. Tasmania, is compared with the other two known members of the genus.

Introduction

Lea (1910) erected the genus *Idacarabus* for his new species, *troglodytes*, which he had earlier collected in Ida Bay Cave, Southeast Tasmania, and which was the first undoubtedly troglobitic beetle discovered in this country. Lea also referred, tentatively, a second new species, *flavipes*, to this genus but he was unable to indicate tribal relationships. Subsequently, Jeannel (1926) showed that *I. troglodytes* was a member of the Merizodini Sloane (= Zolini Sharp).

More recently, I described a further species (*I. cordicollis* Moore, 1967) and have shown (Moore, 1972) that *flavipes* Lea should be transferred to the trechine genus *Tasmanorites* Jeannel. The new species described below is thus effectively the third known member of *Idacarabus*.

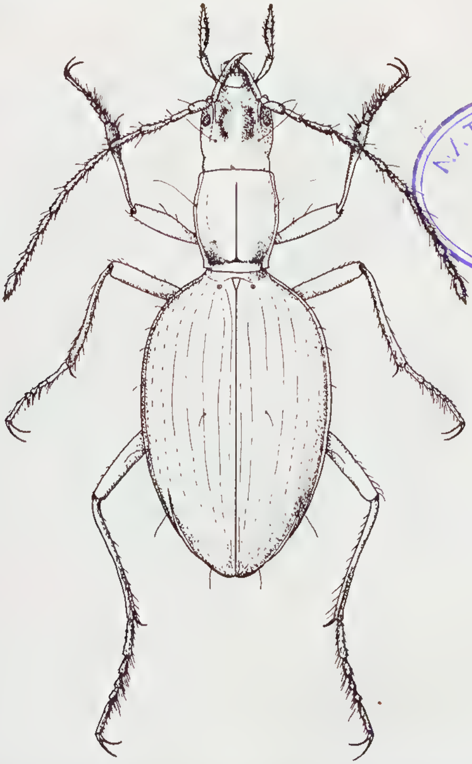


Fig. 1. *Idacarabus longicollis* sp. n., paratype ♀. Natural length 7 mm.

Idacarabus longicollis sp. n. (Figs 1-3)

Elongate; apterous; dark reddish-brown, the appendages lighter.

Head elongate; frontal furrows rather deep, obscurely trifoveate; eyes very small almost flat, with few facets; labrum trapezoidal, sexsetose; mandibles long, slender, acutely pointed; antennae long, slender, pubescent from the base of the third segment. Pronotum fusiform, elongate but somewhat variable in proportions (length/width: 1.1 - 1.17); sides sinuate behind front angles and before hind angles; front angles rounded, closely embracing head; hind angles obtuse but well marked; only the anterior marginal seta present. Elytra fused, ovoid, lightly striate; no scutellary strioles; humeri scarcely apparent; third intervals with 1-2 small setigerous pores, near third striae. Legs long, slender; male anterior tarsi with 2 basal segments weakly expanded and inwardly dentate. Aedeagus (Fig. 2) much as in *troglodytes* Lea but with apical notch more marked.

Length: 7.0 - 7.5 mm. Maximum width: 2.6 - 2.8 mm.

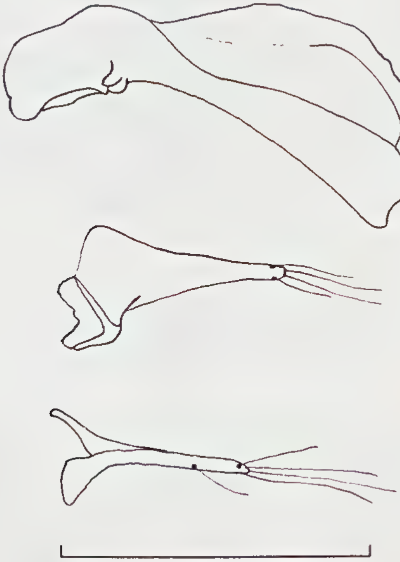


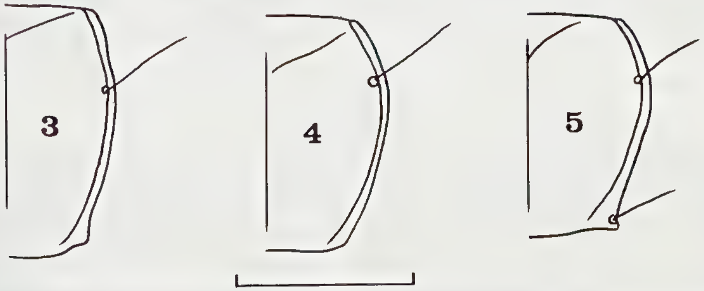
Fig. 2. *Idacarabus longicollis* sp. n., aedeagus in left lateral view, with parameres detached. Scale-line = 0.5 mm.

Holotype ♂, Damper Cave, Precipitous Bluff, S. TASMANIA, 16.i.1973, K. Kiernam, in the South Australian Museum, Adelaide. Paratypes, 1 ♂, 1 ♀, same data as for holotype, 2 ♀♀, same locality, 15-22.i.1973, G. Middleton, 15 ♂♂, 4 ♀♀, same locality, 24.i.1978, A. Goede, in the Australian National Insect Collection, Canberra, the Tasmanian Museum, Hobart, and the author's collection.

Discussion

This new species is close to *troglodytes* Lea (1910), the type of the genus which occurs in the Ida Bay cave system, some 27 km to the east of Damper Cave. However, the pronotum in *longicollis* (Fig. 3) is more obviously fusiform with more marked hind angles than in *troglodytes* (Fig. 4), and the elytra are ovoid whereas in Lea's species they are more nearly pyriform, with better marked humeri. The attenuate build of the new species and the very long appendages suggest a higher degree of adaptation to the cave environment than occurs elsewhere in the genus.

The third described member of *Idacarabus*, *cardicollis* Moore (1967), is known from caves in the Hastings area, not far to the north of Ida Bay, but separated from it by the Lune River watershed. This species is less elongate than the others and more deeply pigmented and these attributes, together with the presence of extra tactile setae on the pronotum (Fig. 5), suggest that it is closest to the ancestral (and presumably epigean) stock. The fact that these three species form a graded series, in terms of decreasing cave-adaptation, over a small arc from southwest to northeast, is probably of some significance and it possibly reflects the extent of time the separate populations have been confined to caves in the three localities. This, in turn, would suggest that the onset of Pleistocene glaciation followed the same trend.



Figs 3-5. *Idacarabus* spp, pronota, right side: (3) *longicollis* **sp. n.**, paratype ♂; (4) *troglodytes* Lea, topotype ♂; (5) *cordicollis* Moore, paratype ♂. Scale-line = 1 mm.

A single specimen of an *Idacarabus* has been collected from a cave in the Mole Creek system, of north-central Tasmania. This specimen indicates a species comparable in adaptation with *troglodytes* and perhaps conspecific with it. At first consideration, this might appear to be in conflict with the above-mentioned trend but it should be borne in mind that Mole Creek is at a somewhat higher elevation than the other localities and is situated close to the Central Highlands, which were the main seat of glaciation in the island, during the Pleistocene (Jennings and Banks 1958). Thus the Mole Creek area may well have been periglacial, and therefore too cold for the survival of surface-dwelling *Idacarabus* stock, at a somewhat earlier time than its latitude would suggest.

Acknowledgements

I wish to thank the collectors of the new species and Mr A. Terauds for the opportunity to study this interesting material.

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BOOK REVIEWS

Handbook of common New Guinea beetles by J.L. Gressitt and R.W. Hornabrook. 1977. Wau Ecology Institute Handbook No. 2. 87 pages, illustr. Available from the Institute, P.O. Box 77, Wau, P.N.G. Price K3.00 (A$3.50) plus postage.

This handbook is an excellent introduction to the beetle fauna of Papua New Guinea. It is designed principally as a guide for those wanting to study or collect New Guinea beetles and is compiled in such a way that no special knowledge of Coleoptera is needed to use the book. On the other hand, it contains information that would interest professional entomologists.

It is essentially a guide to the major beetle families and does not claim to be a comprehensive treatment of the New Guinea fauna but rather a representative selection of the larger and more conspicuous beetles that the average student might find. The Introduction outlines topics such as biology, ecology and zoogeography of beetles and discusses the structure of beetles, with 2 figures included which complement the key to beetle families. It is pleasing to see this useful key which has been simplified, to some extent, in an attempt to make it more practical for the student.

The major portion of the book covers the systematic treatment of the beetle families. Each is discussed in turn and at least one example of most is illustrated. The illustrations are of a high standard and some 100 specimens are figured either as a line drawing or in colour. A list of the figures illustrating species of each of the families treated would have been useful and could have followed the family heading in each case. Another criticism is of the rather disappointing 1½ pages discussing collection and preservation of specimens. Some illustrations would have helped a great deal here, especially when one considers the 1½ blank pages adjoining this section. But these are really minor criticisms of an otherwise very useful book. I recommend this title, not only to those interested in New Guinea beetles, but to all amateur Coleopterists. It is indeed good value for money.

M. S. Moulds

Guide to biological terms in Melanesian Pidgin. by Martin Simon. 1977. Wau Ecology Institute Handbook No. 3. 115 pages, illustr. Available as in title above. Price K2.50 (A$3.00) plus postage.

To those who love the language of Pidgin this book is superb. But to those visitors to Papua New Guinea who hope to use this book the title is slightly misleading. It has been designed for use by indigenous students, who know Pidgin as the lingua franca of the country. It is not designed to be used by foreign biologists visiting the country, unless they know the rudiments of Pidgin. Perhaps a page or so on pronunciation would have helped and this is a thought worth pursuing in any future edition, as biologists visiting Papua New Guinea find the transfer of scientific thought and meaning into Pidgin one of the hardest 'intangibles' to translate.

However, this is small criticism of Handbook No. 3 of the Wau Ecology Institute. I wish it had been available to me when I arrived in Wau in 1966, totally devoid of any knowledge of Pidgin; my life would have been so much easier.

Phillip H. Colman

NOTES ON NOMENCLATURE AND TYPE-SPECIMENS OF AUSTRALIAN PYRGOTIDAE (DIPTERA, SCHIZOPHORA)

By David K. McAlpine
The Australian Museum, Sydney

Abstract

Nomenclature of pyrgotid flies is considered with particular reference to the type material of P. J. M. Macquart. Paratoxurinae Steyskal is a new synonym of Toxurinae Malloch (as Toxurinii). *Paratoxura* Paramonov is a new synonym of *Toxura* Macquart. *Urophora testacea* Macquart and *Paratoxura secreta* Paramonov are new synonyms of *Toxura maculipennis* Macquart. *Epicerella* Macquart, *Parepicerella* Hendel, *Sestroptera* Enderlein, *Pyrgella* Paramonov, and *Musgravena* Paramonov are new synonyms of *Cardiacera* Macquart. *Epicerella plagiata* Bezzi is a new synonym of *Cardiacera dispar* Macquart. *Cardiacera anthonyi* (Paramonov) is restored from synonymy in *C. nova* (Walker). Lectotypes are designated for *Toxura maculipennis* Macquart, *Cardiacera dispar* Macquart, and *Cardiacera nova* Walker. A list of new generic combinations is appended.

Introduction

The last comprehensive work on Australian pyrgotids is that of Paramonov (1958a). Further information on the family has been provided by Paramonov (1958b), and Steyskal (1965, 1968). I now find it necessary to make several corrections to the nomenclature of the family.

Subfamily Toxurinae

Toxurinii Malloch 1929
Paratoxurinae Steyskal 1968: 147.

Steyskal altered the name of this group following the claim of Paramonov (1958a) that *Toxura* was a tephritid (trypetid) genus. Because Paramonov was mistaken, as shown below, the name must revert to that used by Malloch.

I am not convinced that the genera included in this subfamily form a natural group equivalent to the Pyrgotinae. The only distinguishing character, the angular bend in the distal part of the subcosta, is apparently not always to be relied upon as an indication of relationships, and support for the grouping from other characters is minimal. A thorough morphological study of the pyrgotid genera is needed before the interrelationships of genera placed currently in Pyrgotinae and Toxurinae can be understood.

Genus *Toxura* Macquart

Toxura Macquart 1851: 289-290. Type-species *T. maculipennis* Macquart.
Paratoxura Paramonov 1958a: 110. Type-species *P. norrisi* Paramonov. **N. syn.**

Malloch (1929) interpreted *Toxura* as a pyrgotid genus, identifying a specimen, of which he figured the wing, as *T. maculipennis.* Paramonov contended that Malloch had misidentified the type species of *Toxura* and that *Toxura* was really a tephritid and not a pyrgotid. Paramonov had not seen a female of the pyrgotid genus under consideration and thought that Macquart's illustration

(1851: pl. 26, fig. 18) could only represent the abdomen of some unidentified tephritid. He therefore redescribed the genus as new under the name *Paratoxura*. My study of the type material of *T. maculipennis* in the Paris Museum absolutely confirms Malloch's interpretation of the genus, so that *Paratoxura* must be a synonym of *Toxura.* Though highly inaccurate in detail (as is usual for the illustrations in *Diptères exotiques*) Macquart's contentious figure does show some characteristic features of the female abdomen in this genus, notably the enlarged, scoop-like sternite 2 and the elongate, curved segment 7 (ovipositor sheath), though the slenderness of the latter is exaggerated. *Toxura microps* Hendel is at best an outlying member of this genus, having a distinct presutural bristle, extensively haired mesopleuron, and shorter abdominal segment 7 of ♀. The female has, however, the particularly long tarsal claws, almost straight over much of their length, characteristic of this sex in *Toxura*, and the species is probably more closely related to this than to any other named genus.

Toxura maculipennis Macquart

(Figs 1, 2)

Toxura maculipennis Macquart 1851: 290, pl. 26, figs 18, 18a; Malloch 1929: 24, fig. 3.

Urophora testacea Macquart 1851: 287, pl. 26, fig. 12. N. syn.

Paratoxura secreta Paramonov 1958a: 111-112, fig. 10. N. syn.

As first reviser under Article 24 (a) of the International Code, I choose the name *T. maculipennis* in preference to *U. testacea* of Macquart's two simultaneously published synonyms.

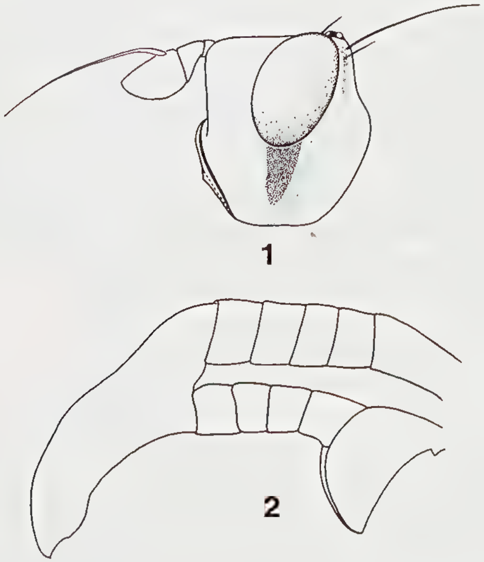
This may be distinguished from other species of *Toxura* I have seen by the following characters: face with pair of black stripes; antennal segment 3 subacute to acute; mesoscutum with only one pair of dark (black) stripes, interrupted at suture; humeral bristle long and fine; mesopleuron bare except on posterior margin.

Though there is no doubt that the specimen determined by Malloch as *T. maculipennis*, the wing of which is illustrated, belongs to the same narrow group of species as this, Malloch's published data are too meagre to enable certainty as to the correctness of his specific identification. The specimen is now apparently lost as it is not in any of the collections where it might be expected to be found (School of Public Health and Tropical Medicine, Australian Museum; British Museum (Natural History), Australian National Insect Collection (C.S.I.R.O.), or United States National Museum).

The type of *Urophora testacea* agrees in all significant details with the types of *T. maculipennis.*

Paramonov did not mention a type specimen for his *P. secreta.* However he expressly introduced this name as a replacement name ("nom. nov.") for "*Toxura maculipennis* Malloch (nec Macquart), 1929..," though he had seen neither Malloch's nor Macquart's material. Under these circumstances Article 72 (d) is the only rule in the International Code which can be invoked to determine which is type material, and this indicates unambiguously that the new name has the same type material as the name it replaces. As Malloch's *T. maculipennis* has no separate nomenclatural status, its type material can be only that of *T. maculipennis* Macquart. Though application of this rule sets aside the stated intention of Paramonov, the possibility of its setting aside the intentions of the author of a new name is explicit in the wording, and it should be upheld.

Type material examined: "Tasmanie", reg. no. 3/47 (lectotype ♀, here designated, of *T. maculipennis*, paralectotype ♀, Paris Museum), J. P. Verreaux (the paralectotype is the specimen in poorer condition, but bearing a printed red "TYPE" label); "Tasmanie" (published locality, not on label) reg. no. 3/47 (holotype ♀, head missing, of *Urophora testacea*, Paris Museum), J. P. Verreaux. Though not all of Verreaux's supposedly Tasmanian material is correctly labelled (McAlpine, 1973: 180-181), the material of this species is probably correctly localised. A further ♀ from Saint Patrick's River, Tasmania (South Australian Museum) is evidently conspecific, but is distinct from the few specimens of *Toxura* from the Australian mainland available to me.



Figs 1, 2. *Toxura maculipennis,* lectotype ♀: (1) head, freehand, proboscis and minor hairing omitted; (2) abdomen, vestiture omitted.

Genus *Cardiacera* Macquart

Cardiacera Macquart 1847: 92, 99, 101, pl. 6; 1851: 362. Type-species *C. dispar* Macquart.

Cardiocera Macquart 1847: 92 (variant spelling of above); Paramonov 1958: 107-108.

Epicerella Macquart 1851: 293-294. Type-species *E. guttipennis* Macquart. N.syn.
Parepicerella Hendel 1934: 145. Type-species *Epicerella miliacea* Hendel. N.syn.
Sestroptera Enderlein 1942: 100. Type-species *Epicerella multipunctata* Malloch.
N. syn (see Paramonov 1958a: 124).
Pyrgella Paramonov 1958a: 116. Type-species *P. calabyana* Paramonov. N. syn.
Musgravena Paramonov 1958a: 117. Type-species *M. anthonyi* Paramonov. N.syn.

Of the two spellings used by Macquart in the original publication. *Cardiacera* must be used as that chosen by Macquart (1851) as first reviser in accordance with Article 24(a) of the International Code. Despite the view of Paramonov, it must be noted that the alternative spelling appears only once, apparently as a lapsus calami.

Though most species of this genus have been referred to the genus *Epicerella*, the type species of this nominal genus is congeneric with that of *Cardiacera*, as shown from my examination of type material of both *C. dispar* and *E. guttipennis* at the University Museum, Oxford.

Also *Parepicerella* must be synonymised because its type species is only doubtfully distinct from that of *Epicerella* (see under *C. guttipennis,* p. 31).

Paramonov included in his genus *Pyrgella* two species which from his key may be judged to differ from the species he placed in *Epicerella* in the deeply sunken keel on the upper part of the face and the less strongly developed wing markings. However there are species included by Paramonov in *Epicerella* which quite closely approach the species of *Pyrgella* in both these characters. Another character of *Pyrgella,* the presence of only one pair of dorsocentral bristles. occurs also in "*Epicerella*" in which Paramonov allows species with one to five pairs of such bristles. As the two species of *Pyrgella* conform in general with the large and somewhat varied assemblage of species included in *Epicerella,* there is no adequate reason for maintaining them in a separate genus.

Paramonov separated *Musgravena* from *Epicerella* on account of "a break in the costa (deep incision) at the apex of the subcostalis, hyaline wings, and extremely strange form of genitalia". The unique holotype of *M. anthonyi* has an unbroken costa (apart from the post-humeral incision), there being simply a rather strong bend at junction with the subcosta, which evidently misled Paramonov. The wing is no more completely hyaline than in several other species of "*Epicerella*". The structure of the female abdomen was misinterpreted by Paramonov and its peculiarities exaggerated. The segmentation is normal for a female pyrgotid. The apex of segment 7 is constricted and curved upwards whereas in other related species it is often constricted and decurved. The terminal structures in species of *Cardiacera* are quite diverse but sclerotized plates somewhat resembling the "claspers" of *M. anthonyi* are present in some, though usually retracted. I conclude that there is no satisfactory morphological basis for the separation of the genus *Musgravena* from *Cardiacera.*

Cardiacera dispar Macquart

Cardiocera dispar Macquart 1847: 92, figs 3-3c; Paramonov 1958a: 108-110, fig. 9 (after Macquart).

Epicerella plagiata Bezzi 1929: 11-12; Malloch 1929: 25; Paramonov 1958a: 124. **N. syn.**

The two nominal species are clearly synonyms from my examination of type material of both. The type locality of *C. dispar* is probably in the vicinity of Sydney, New South Wales, and not "Tasmanie" as given by Macquart (see McAlpine 1973: 180-181, for discussion of a similar case).

Type material examined: not individually labelled but placed above cabinet label "Cardiacera dispar. ♂ ♀ n.g. n.sp. Macq. Van Diemen. Macq. D. Exot. nomint" (lectotype ♂, here designated, the only extant syntype, Oxford). Sydney, New South Wales, 12.xi.1923 (holotype ♂ of *E. plagiata*, School of Public Health and Tropical Medicine, Sydney), anon.

Cardiacera guttipennis (Macquart), n. comb.

Epicerella guttipennis Macquart 1851: 294, pl. 27, fig. 9.

Examination of the now much damaged type shows this species to be very similar to *C. miliacea*, which Hendel made the type of a separate genus, *Parepicerella*. The type specimen differs from available specimens of *C. miliacea* in having one instead of two fronto-orbital bristles and in its larger size (length of wing c. 13.5 mm), but I am doubtful if it represents a separate species. The type cannot be run to *E. guttipennis* in Paramonov's key to species of *Epicerella*, as it has three hyaline spots in "pterostigma" and a spur or stump on vien 2, but it runs imperfectly to *E. miliacea.*

As with *C. dispar* the true type locality is probably in the vicinity of Sydney, but no closely similar specimen from the Sydney district is available to me.

Holotype ♂ (sex fide Macquart as abdomen now missing): "Tasmanie" (Oxford).

Cardiacera nova (Walker) n. comb.

Tetanocera nova Walker 1849: 1084-1085.
Musgravena nova Steyskal 1965: 447.

Steyskal, from study of type material of *T. nova* alone, considered this to be a senior synonym of *Musgravena anthonyi* Paramonov, 1958a. The late Dr Paramonov told me that he disagreed with this synonymy and that two closely related species were probably involved.

My own detailed study of type material of both *T. nova* and *M. anthonyi* seems to confirm Paramonov's view. As I have not had the two specimens under examination simultaneously, I must rely on a comparison of my detailed notes on the lectotype of *T. nova* with the holotype of *M. anthonyi. M. anthonyi* has no ocellar bristles, wheras distinct ocellars are present in *T. nova*; *M. anthonyi* has tawny humeral calli with some pale pruinescence, the colouring being similar to that of most of the mesoscutum, while in *T. nova* the humeral calli are pale yellowish, contrasting with the deeper reddish tawny mesoscutum; in

M. anthonyi the abdomen is nearly all black, in *T. nova* nearly all tawny; *M. anthonyi* is considerably larger than *T. nova.* It is also possible that there are differences in the bristling of abdominal segment 7. *M. anthonyi* has the posterior extremity of segment 7 (♀) dorsally with a dense tuft of long bristles or bristle-like hairs on each side, arising from a slight gibbosity, the median part near posterior margin being bare; in *T. nova,* according to my notes, the posterodorsal part of segment 7 is simply densely haired.

I conclude that the differences between these two specimens are too great to allow the likelihood of their being variants of the one species. I therefore restore *Cardiacera anthonyi* (Paramonov) n. comb. to the status of a valid species.

Lectotype ♀ (here designated) of *T. nova*: "New Holl. . . 1844-12" (British Museum (Natural History)), "Pres. by the Ent. Club". Walker referred to both sexes, but this is apparently the only syntype now existing.

List of new generic combinations

* *Toxura norrisi* (Paramonov), from *Paratoxura*
Cardiacera calabyana (Paramonov), from *Pyrgella*
Cardiacera carnei (Paramonov), from *Pyrgella*
Cardiacera anthonyi (Paramonov), from *Musgravena*
Cardiacera nova (Walker), from *Tetanocera, Musgravena*
Cardiacera punctulata (Hendel), from *Epicerella*
Cardiacera cribripennis (Bezzi), from *Acropyrgota, Epicerella*
* *Cardiacera norsemanica* (Paramonov), from *Epicerella*
* *Cardiacera inermis* (Paramonov), from *Epicerella*
* *Cardiacera bella* (Paramonov), from *Epicerella*
Cardiacera guttipennis (Macquart), from *Epicerella*
* *Cardiacera setosa* (Bezzi), from *Epicerella*
* *Cardiacera multipunctata* (Malloch), from *Epicerella*
* *Cardiacera montana* (Paramonov), from *Epicerella*
Cardiacera miliacea (Hendel), from *Epicerella, Parepicerella*
* *Cardiacera uniforma* (Paramonov), from *Epicerella*
* *Cardiacera campbelli* (Paramonov), from *Epicerella*
* *Cardiacera triangularis* (Malloch), from *Epicerella*
Cardiacera nigrescens (Paramonov), from *Epicerella*
* *Cardiacera acuticornis* (Paramonov), from *Epicerella*
Cardiacera strumosa (Bezzi), from *Epicerella*
Cardiacera minor (Bezzi), from *Epicerella*
Cardiacera maculipennis (Bezzi), from *Epicerella*
Cardiacera latifrons (Paramonov), from *Epicerella*
* *Cardiacera armipes* (Paramonov), from *Epicerella*
* *Cardiacera imitatrix* (Paramonov), from *Epicerella*
* *Cardiacera simulatrix* (Paramonov), from *Epicerella*
* *Cardiacera rava* (Paramonov), from *Epicerella*

Cardiacera barringtoni (Paramonov), from *Epicerella*
* *Cardiacera noctua* (Paramonov), from *Epicerella*
* *Cardiacera pilosocula* (Paramonov), from *Epicerella*
* *Cardiacera ocelligera* (Paramonov), from *Epicerella*
* *Cardiacera bourkei* (Paramonov), from *Epicerella*

The above combinations may be reasonably inferred from the new generic synonymy here established. Species which I have not examined in connection with the present work are marked with an asterisk (*). I am not prepared to recommend the transfer of any non-Australian species to *Cardiacera* without further study.

Acknowledgements

I am indebted to Dr H. G. Cogger and Mr G. C. Steyskal for discussion of some of the problems dealt with here, and to Miss M. A. Schneider for assistance in the preparation of the paper. This research has been aided by generous grants from the Australian Research Grants Committee and C.S.I.R.O. Science and Industry Endowment Fund.

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EXTENSION OF THE KNOWN RANGE OF THE AUSTRALIAN FRITILLARY *ARGYNNIS HYPERBIUS INCONSTANS* BUTLER (LEPIDOPTERA: NYMPHALIDAE)

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The Australian Fritillary butterfly *Argynnis hyperbius inconstans* Butler has been recorded from a relatively small area ranging from Gympie to Urunga (Common and Waterhouse, 1972; Binns, 1976). The life history has only recently been described (Lambkin and Lambkin, 1977).

On 6th November 1977 a perfect male was captured by the present author in coastal swampland approximately 5 km north of Port Macquarie, N.S.W., in an area close to the road to Point Plomer. The insect landed on an old fencepost, whereupon it was netted. A search revealed no further specimens. This interesting record extends the known range of this butterfly more than 100 km southwards.

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BOOK REVIEW

The insects. A collection of articles from *Scientific American* selected and introduced by T. Eisner and E. O. Wilson. 1977. 4to. W. H. Freeman, San Fransisco. 334 pages, illustr. Price $10.95.(Copy supplied by ANZ Book Co. P/L.)

This book is a fascinating collection of 35 articles from the well-known international periodical, *Scientific American.* The articles are grouped to form 5 chapters, the entire work and each chapter being furnished with an introduction by Thomas Eisner and Edward Wilson who compiled the collection. The chapters concern anatomy and physiology, neurobiology and behaviour, evolution and ecology, diversity of life styles and insects and mankind.

The articles give in-depth coverage to basic topics such as genetics, respiration, metabolism, growth, hormonal regulation, flight, social life, ecology and the economic importance of insects. All are written by acknowledged authorities in each particular field and include such notable authors as Paul Ehrlich, Howard Evans, H. E. Hinton, C. G. Johnson, Miriam Rothschild, D. F. Waterhouse and V. B. Wigglesworth. All articles are illustrated, the illustrations being of a high standard and very appropriate to the text.

Those who enjoy reading *Scientific American* will certainly enjoy this book. All entomologists, whether amateur or professional, cannot help but benefit from reading it. The articles are written in an easy to read style and the index at the back permits the work to be used as a reference book. As such, it is good value for money.

M. S. Moulds

RECORDS OF SCARABAEOIDEA (COLEOPTERA) FROM CHARLEVILLE, QUEENSLAND

By P. G. Allsopp
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The town of Charleville (26°25′S, 146°13′E) is approximately 650 km west of Brisbane and lies within an extensive grazing district. The area surrounding the town is virtually flat, about 300 m above sea level, and, apart from along the watercourses, is covered by mulga scrub. Rainfall is low, an average of 45 cm per annum, and temperatures fluctuate from a mean monthly minimum of 4.5°C in July to a mean monthly maximum of 36.4°C in January.

In the more recent major revisions of Australian scarabs (Britton 1957; Carne, 1957a, 1957b, 1958; Matthews, 1972, 1974, 1976) there are no records of any species from Charleville. During the period January 1973 to October 1975, numerous visits were made to the district and the opportunity to collect scarabs was taken. Collection methods involved the use of black-light traps and baited pitfall traps as well as digging specimens from burrows, animal manure and mushrooms.

Specimens of those species not determined to specific level in this paper have been lodged in the collection of the Queensland Department of Primary Industries, Brisbane. Duplicate specimens are in the author's collection.

It is interesting to note that no specimens of the Rutelinae or Centoniinae were found during this study. Carne (1958) notes that the majority of species of Australian rutelines occur on or near the coast, very few on the arid interior. The only species recorded from south-west Queensland is *Eusaulostomus minicus* (Lea) from Cunnamulla, 200 km south of Charleville (Carne, 1956). The Australian Centoniinae require revision and there is no paper in which adequate distributional data is presented to allow a comparision of the Charleville region.

List of species

SCARABAEINAE

Onthophagus atrox Harold. Very common from October to April. Taken at cow and sheep dung, human excrement and at light. A westward extension of its known range (Matthews, 1972).

Onthophagus consentaneus Harold. Common from February to April. Taken at cow dung, human excrement and decaying fish bones. According to Matthews (1972) this species has the most extensive distribution of any Australian *Onthophagus*.

Onthophagus perpilosus Macleay. Taken only at cow dung during March. Matthews (1972) gives Roma (270 km east of Charleville) as the most western record.

Onthophagus pugnacior Blackburn. Very common during October to April. Taken at cow, sheep and horse dung, human excrement, light and in burrows. A common central Queensland species (Matthews, 1972).

Onthophagus varianus Lea. A large number of specimens were taken on 2.iv.1975 in mushrooms 1.5 km east of Charleville. Only recorded from Bowen, Queensland, and the north of the Northern Territory by Matthews (1972).

Onthophagus sp. A. One specimen of an undescribed species was taken in cow dung and another in mushrooms on 2.iv.1975.

Onthophagus sp. B. One specimen of this species was taken in a mushroom on 2.iv.1975. Matthews (pers. comm.) labelled the specimen as "sp. nr. *dunningi*", but he considered that a male was needed before saying if it represented a new species.

Euoniticellus intermedius Reiche. This introduced species was found in large numbers in cow, horse and sheep dung from the beginning of 1974 onwards.

APHODIINAE

Aphodius lividus Olivier. Specimens were found in cattle dung and at light during October, November and December.

Aphodius sp. Five specimens of this species were taken at light on 10.x.1974 about 0.5 km south of Charleville.

DYNASTINAE

Metanastes vulgivagus (Olliff). All Queensland records given by Carne (1957) are either coastal or sub-coastal but taken at St. George by Allsopp (1975). Specimens taken at Charleville during October at light.

Neodon laevipennis (Blackburn). One specimen taken at a street light on 13.iii.1973. Recorded by Carne (1957) from many places in the interior of Australia.

Neodon pecuarius (Reiche). Common during October and November at light. A species with a wide distribution and very common throughout Australia.

MELOLONTHINAE

Colpochila firma (Blackburn). One specimen taken in a burrow approximately 20 cm deep on 2.iv.1975.

Gnaphalopoda sp. One specimen taken at light 2.iv.1975.

Heteronyx sp. A. More than 30 specimens were taken at light on 30.x.1975 about 1.5 km east of Charleville.

Heteronyx sp. B. One specimen taken at light 16.iii.1974 in Charleville.

Lepidiota squamulata Waterhouse. One dead specimen taken on a footpath in Charleville 16.iii.1974.

Liparetrus rufipennis Macleay. A male of this species was taken from a shallow burrow on 2.iv.1975.

Maechidius charaxus Britton. Two specimens taken at light 30.x.1975. Britton (1957) only records this species from Cloncurry, 860 km north-west of Charleville.

TROGIDAE

Trox sp. One specimen was taken at light on 13.iii.1973 and two more on 3.iv.1975. Five other specimens were found in sandy soil under rotting fish bones on 2.iv.1975.

GEOTRUPIDAE

Australobolbus carinatus (Blackburn). Two specimens were dug from burrows 10-15 cm deep in sandy soil on 2.iv.1975.

Australobolbus laevipes (Blackburn). Three specimens taken in burrows similar to those of *A. carinatus* on the same date. Both species were taken in the same area.

Australobolbus sp. One specimen was taken at light on 9.xi.1973 – none were found in burrows.

Blackburnium sp. A single well-developed male was taken in a 20 cm deep burrow in sandy soil on 30.x.1975. Within the general generic distribution given by Howden and Cooper (1977).

Bolbobaineus planiceps (Macleay). One specimen taken in a shallow burrow on 2.iv.1975.

Bolboleaus truncatus (Blackburn). Two specimens were taken at light on 9.xi.1973 and a further 20+ specimens taken in burrows 20-40 cm deep in sandy soil on 2.iv.1975. Within the general generic distribution given by Howden and Cooper (1977).

Bolborhachium sp. *recticorne* (Guerin) group. One specimen taken in a burrow similar to that of *A. carinatus* on 2.iv.1975. Within the general generic distribution given by Howden and Cooper (1977).

Bolborhachium sp. nr. *fissicorne* (Bainbridge). One specimen taken at light on 19.v.1973.

Stenaspidius allsoppi Howden. Two male specimens, the holotype and a paratype, were taken in shallow burrows, 5 cm deep, in sandy soil on 2.iv.1975. The only other record of this species (Howden, 1976) is from Leyburn, 600 km south-east.

Acknowledgements

Dr E. G. Matthews identified some of the Scarabaeinae, Dr E. B. Britton, the Melolonthinae and Prof. H. F. Howden, the Geotrupidae. The assistance of these gentlemen is gratefully acknowledged.

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AN ACCUMULATIVE BIBLIOGRAPHY OF AUSTRALIAN ENTOMOLOGY

Compiled by M. S. Moulds
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This bibliography lists, in an accumulative manner, all literature published since the beginning of 1972 that directly concerns Australian insects. It attempts to fulfil the need for a comprehensive list of current Australian entomological literature. If you have published anything likely to be overlooked I would be greatful for reprints or details of such publications.

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EXCHANGE. I would like to contact anyone interested in exchanging Australian butterflies. Please write to Mr Allen Sundholm, 2/68 Mountford Ave, Guildford, N.S.W. 2161.

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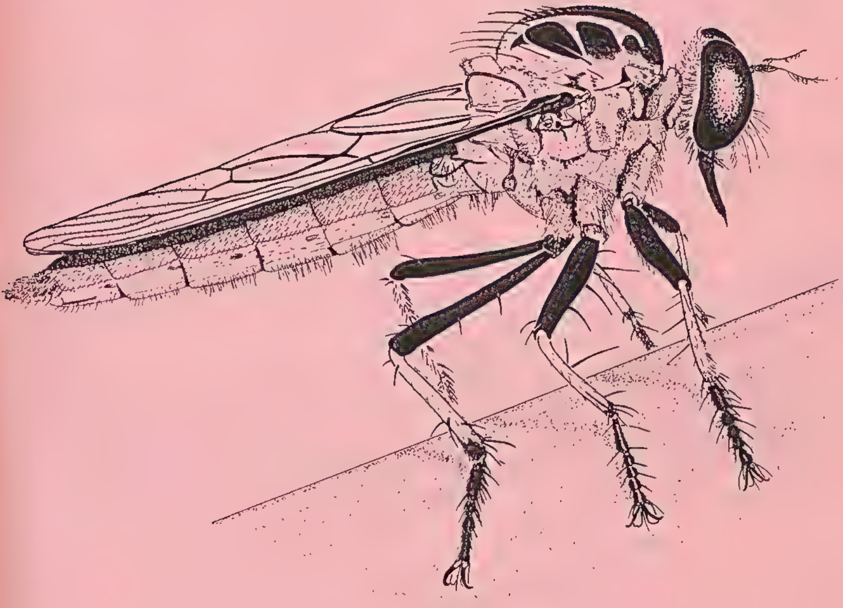

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COVER

Illustrated by Greg Daniels.

Depicts the Australian robber fly, *Ommatius angustiventris* Macquart, a common species found throughout the east coast from central Queensland to eastern Victoria. One of the few Australian Asilidae that has adapted to suburban gardens, its larvae are found in rich loamy soils. The adults prey on insects of many orders and usually catch them in flight.

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THE DISTINCTION BETWEEN *HYPOLIMNAS ANTILOPE* (CRAMER) AND *H. ANOMALA* (WALLACE) (LEPIDOPTERA: NYMPHALIDAE), AND THE OCCURRENCE OF *H. ANOMALA* IN AUSTRALIA

By I. F. B. Common
CSIRO, Division of Entomology, P.O. Box 1700, Canberra City, A.C.T. 2601

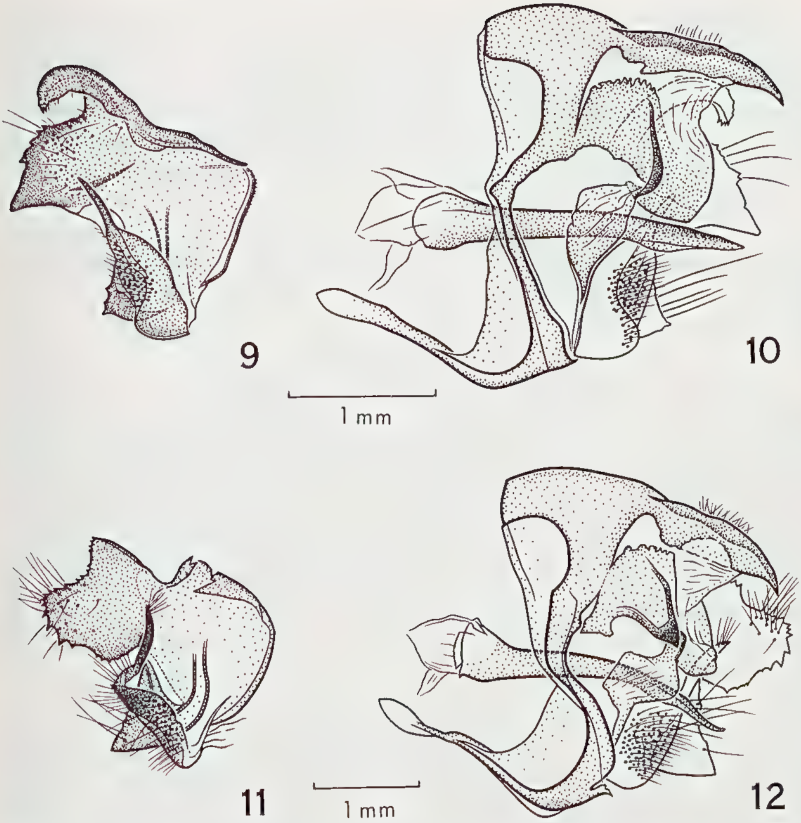
Abstract

Hypolimnas anomala (Wallace) is separated from *H. antilope* (Cramer) by the male genitalia and other characters, and is here recorded from Australia. Adults of both species and the male genitalia are figured.

Hypolimnas antilope (Cramer), 1777, has customarily been treated as a widely distributed species, with many subspecies occurring in an area extending from Malaya and the Philippines in the north, through the Indonesian chain of islands to New Guinea and the Solomons. The type locality is Ambon (Amboina) in the Moluccas. Waterhouse and Lyell (1914) recorded and figured a male specimen (Figs 1, 2) from Darwin as *H. antilope*, collected by F. P. Dodd in March 1909 and now in the Australian Museum, Sydney. This they attributed to the Timorese subspecies *albula* Wallace, 1869. A second male specimen from Australia (Figs 3, 4) was recorded as *H. antilope* by Gibb (1977) who collected it at Lockerbie near the tip of Cape York Peninsula in April 1975.

While comparing the two Australian specimens with others in the Australian National Insect Collection identified as *H. antilope* from Christmas Island (near Java) and from various New Guinea and Solomons localities, I noticed that the termen of the hindwing in males from Christmas Island and Australia appeared to be slightly more flattened than in New Guinea males. Specimens from New Guinea and the Solomons also had the ground colour in the apical half of the forewing slightly paler than in the remainder of the wing, a feature absent in specimens from Christmas Island and Australia. This was especially noticeable in males. Figures in Fruhstorfer (1911-16) and in Corbet and Pendlebury (1956) seemed to confirm that males from Malaya (Figs 5, 6) and other localities west of the Moluccas tended to differ, like the Christmas Island and Australian specimens, from those originating in Ambon (Figs 7, 8) and areas farther east.

Figs 1-8. *Hypolimnas* spp., above (left), beneath (right). (1, 2) *H. anomala*, male, Darwin, N.T.; (3, 4) *H. anomala*, male, Lockerbie, Cape York, Queensland; (5, 6) *H. anomala*, male, Taiping, Malaya; (7, 8) *H. antilope*, male Ambon, Moluccas.



Figs 9-12. Male genitalia of *Hypolimnas* spp., lateral view, with left valva removed. (9, 10) *H. anomala*, Christmas Island; (11, 12) *H. antilope*, Angoram, Sepik District, Papua New Guinea.

Examination of specimens from Malaya, Sumatra, Christmas Island, Australia, Ambon, various localities in New Guinea, the Admiralty Islands and the Solomons has confirmed these distinctions, especially the paler apical half of the forewing in populations from the Moluccas and localities farther east. Wallace (1869) in fact used this character to distinguish the male of *H. antilope* from other species in the genus. Comparison of the male genitalia of specimens from Malaya, Christmas Island (Figs 9, 10), Darwin and Cape York, on the one hand, with those from Ambon and New Guinea (Figs 11, 12) on the other, showed major differences in structure, especially of the valvae, between these two groups of populations. Of special note is the strongly protruding and curved dorsal margin and the downwardly pointed and only slightly dentate distal margin of the valva in *H. anomala*. In *H. antilope* the dorsal margin of the valva curves inwards but does not protrude apically, and the distal margin has no major projection but is much more dentate. These differences are of sufficient magnitude to support the specific separation of the two groups.

The name *H. antilope* should therefore be restricted to populations from the Moluccas, New Guinea, the Admiralty Islands, and from the Bismarck Archipelago to the Solomons. The oldest available name for populations occurring west and north of the Moluccas is *H. anomala* Wallace, 1869, the original specimens of which came from Malacca in Malaya (male) and from Java (female). This name has page precedence over *H. albula* Wallace, from Timor.

Vane-Wright *et al.* (1977) are the only recent authors who have treated these two groups of populations as separate species, under the names *H. antilope* and *anomala*, but have given no explanation for doing so. However, Mr Vane-Wright informed me (personal communication) that they considered it reasonable to treat the two as semi-species because of their pattern morphism characteristics, but had not studied their genital morphology.

The two Australian specimens, previously identified as *H. antilope,* should now be referred to *H. anomala.* They lack the slight blue gloss on the upper surface of both wings found in most, but not all specimens of both sexes of *H. anomala* from Malaya and Indonesia. Although their white markings, especially in the Queensland specimen, may be more restricted than in the Timor subspecies *albula,* Australian specimens have presumably originated in that area. Whether they represent breeding populations in Australia, or are casual immigrants, is not known. It is of considerable interest, however, that Gibb's specimen from Cape York could not have reached Queensland from New Guinea, as might have been expected, but must have come from the west, presumably via the Northern Territory.

Acknowledgements

Thanks are due to Lt.-Col. J. N. Eliot and to Mr R. I. Vane-Wright, British Museum (Natural History), for comments, and to Mr Vane-Wright for the loan of specimens from Ambon, Malaya and Sumatra. I am also grateful to Mr W. F. Gibb for lending his specimen of *H. anomala* from Cape York, and to Dr C. N. Smithers for lending the Australian Museum specimen from Darwin. Mr S. P. Kim prepared the line drawings and Mr J. P. Green the photographs.

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A NEW SPECIES OF *PSEUDODIPSAS* C. & R. FELDER (LEPIDOPTERA: LYCAENIDAE) FROM NORTHERN NEW SOUTH WALES

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and
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Abstract

Pseudodipsas arcana sp.n. is described, figured, and compared with related *Pseudodipsas* species. A key to Australian species of *Pseudodipsas* is given.

Pseudodipsas arcana sp. n.
(Figs 1, 2, 5, 6, 9, 11, 13, 15, 17)

Types:– NEW SOUTH WALES: *Holotype* ♂, 24 km W. Grafton, 23.ix.1976, C. G. Miller, genitalia tube 198, Reg. No. 3286, in Australian National Insect Collection. *Paratypes:* 20♂, 7♀, 1♀ same data as holotype, in Australian National Insect Collection; 14♂, 4♀, labelled similarly but dated 15.ix.1974, 16.iii.1975, 5.iv.1975, 11.x.1975, 5.iii.1976, 9.iii.1975, 23.iii.1975, 23.ix.1976, 10.x.1976, 19.xii.1976, 9.i.1977, 25.iii.1977, 2.iv.1977, 10.iii.1978, 11.iii.1978, in C. G. Miller collection; 2♂, 24 km W. Grafton, 13.x.1974, I. G. Morhaus, in I. G. Morhaus collection; 1♂, 2♀, 25 km W. Grafton, J. F. R. Kerr, dated 3.i.1976 and 26.i.1976 in J. F. R. Kerr collection; 1♂, 24 km W. Grafton, 24.xi.1977, R. Field, in R. Field collection; 2♂, 24 km W. Grafton, 25.i.1976, 27.i.1976, J. d'Apice in J. d'Apice collection.

Distribution:– The species has been found only on a single hill-top about 24 km west of Grafton, New South Wales.

Description:– *Male* (Figs 1, 5). Head dark grey with some white scales; frons white with two vertical bars of dark grey; antennae black ringed with white, club black, unscaled tip orange; labial palpi black above with some white scales, beneath terminal segment black, second segment black towards tip, white towards base. Thorax: above black, clothed in long dark grey hair-scales; beneath white, clothed in long white hair-scales; legs clothed in long white hair-scales. Abdomen above dark grey, beneath pale grey. Fore wing above: bronze-brown, grey-brown towards base; a triangular area extending from dorsum to discal cell with slight copper tinge; veins in median area lined with black scales; fine terminal line dark brown; cilia brown with white tips except near tornus where dark brown. Hind wing above: bronze-brown, grey-brown towards base; costal and inner margins brown, veins lightly coated with black scales; a black spot at termen between CuA_1 and CuA_2; another black spot, smaller and split by orange scales, between CuA_2 and $1A + 2A$; a few blue scales between black spots and termen; fine terminal line dark brown; cilia dark brown with white tips except at end of CuA_2 and $1A + 2A$ where cilia longer, tuft-like and without white tips; long hair-scales at base and along inner margin brown. Fore wing beneath: grey-brown; bands darker grey-brown prominently margined with white; small subbasal band in cell; submedian band from radial vein to $1A + 2A$ broken at CuA_2; median band at end of cell from M_1 to M_3; postmedian band from costa to $1A + 2A$ with sections displaced at M_3 and CuA_2; subterminal band from costa to $1A + 2A$ fainter; fine terminal line dark brown; cilia brown. Hind wing beneath: grey-brown; bands darker grey-brown, prominently margined with white; subbasal band of three spots from $Sc + R_1$ to CuA_1; submedian band from $Sc + R_1$ to $1A + 2A$ broken; median band at end of cell between M_1 and M_3; postmedian band from $Sc + R_1$ to inner margin with sections displaced at every vein except M_2; subterminal band fainter, crenulate from $Sc + R_1$ to inner margin; large black spot near termen between CuA_1 and CuA_2 and another divided by orange scales along 1A + 2A, black spots with proximal line of orange scales and distal line of pale blue or white scales; fine terminal line dark brown; cilia brown, with white tips towards tornus except at end of CuA_2 and 1A + 2A where cilia dark brown. longer and tuft-like. Length of fore wing 10.5 mm to 12.5 mm.

There is little variation on the uppersides of both sexes, but the undersides, particularly in the males, vary in the widths of the dark bands and the degree of prominence of the white margins of the bands.

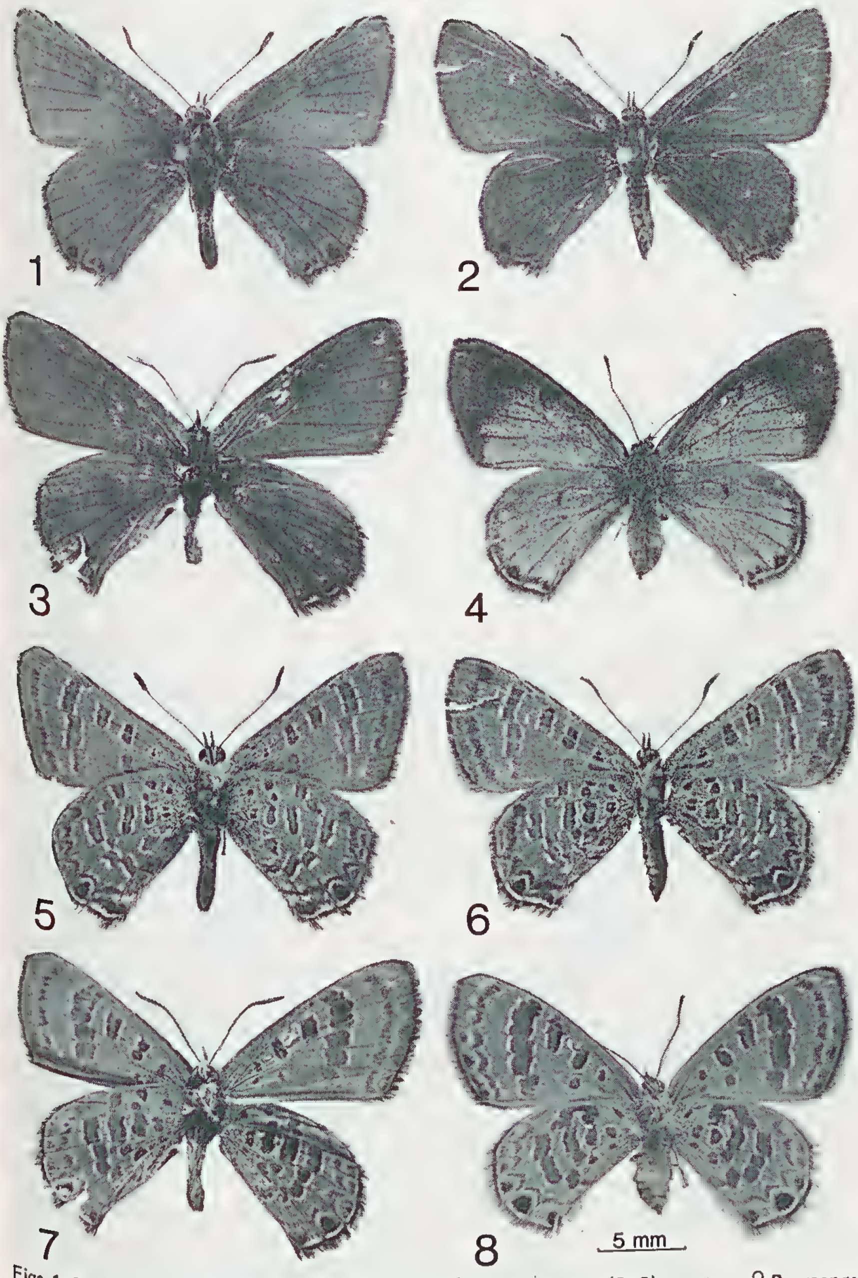
Male genitalia .(Figs 9, 11, 13, 15). Uncus produced into two processes (A) well separated at base; uncus spreading; tip of valva short, robust and hook-like; ring formed by vinculum oval in anterior view; aedeagus gradually curved with pointed tip.

Female (Figs 2, 6). Head, thorax and abdomen as in male. Fore wing above: bronze-brown, grey-brown towards base; termen more rounded and more broadly black than in male; cilia as in male. Hind wing above: slightly darker bronze-brown than fore wing, grey-brown towards base; tornal spots as in male but with a few more blue scales distally and a few blue scales proximally; cilia as in male. Fore wing beneath: as in male but slightly darker; terminal line broader and with faint pale line proximal to it. Hind wing beneath: as in male but differs in the same way as the fore wing. Length of fore wing 12 mm to 13 mm.

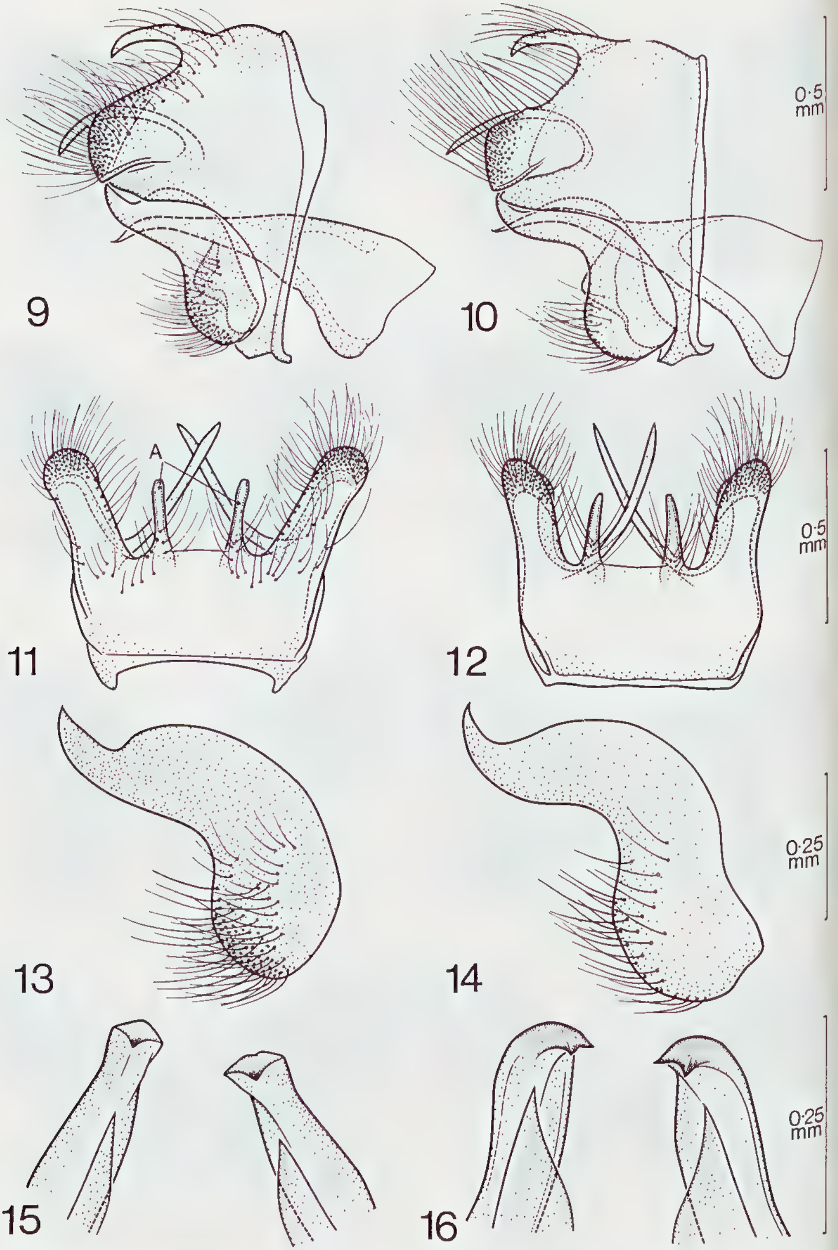
Female genitalia. Because the females of this group are rare in collections the female genitalia have not been examined.

Discussion

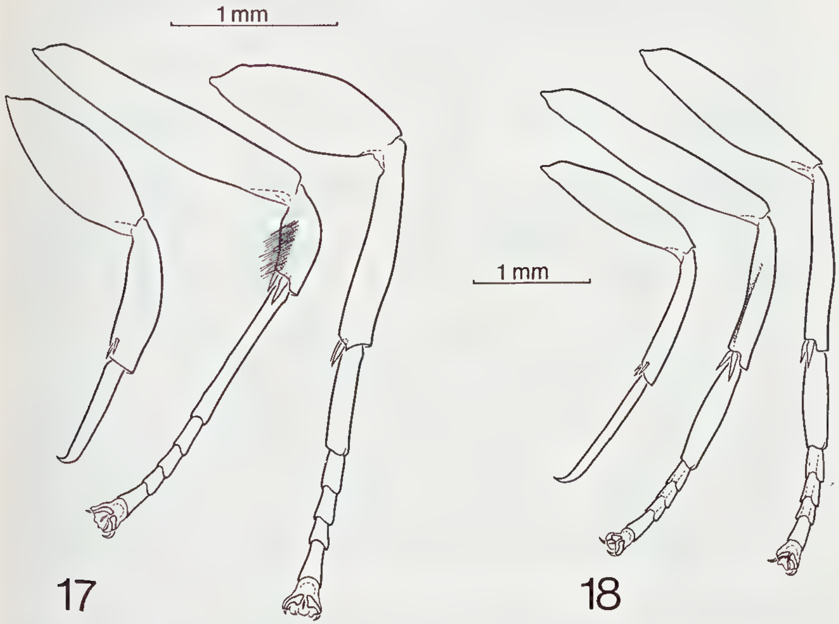
P. illidgei Waterhouse and Lyell, *P. arcana,* and an undescribed species from Cape York Peninsula, may be immediately distinguished from other species of *Pseudodipsas* by their legs. Both sexes in the *P. illidgei* group have the fore and hind femora swollen and the mid tibia is shorter than the first tarsal segment of the mid leg (Figs 17, 18). In males of *P. arcana* the apex of the fore wing is more pointed, the termen straighter, and the termen of the hind wing is more angled at Rs and more bowed inwards between CuA_2 and 1A + 2A than in *P. illidgei.* The uppersides of females of *P. arcana* lack blue areas, except for a few scales around the tornal spots, and so differ markedly from females of *P. illidgei, P. myrmecophila* Waterhouse and Lyell, and *P. brisbanensis* Miskin. In both sexes of *P. illidgei* the dark bands beneath are broader, darker and show less displacement at the veins, than do those of *P. arcana* (Figs 1-8). The male genitalia of the two are similar but the uncus of *P. arcana* spreads more widely in dorsal view than that of *P. illidgei* (Figs 9-12). Differences may also be found in the relative proportions of the tegumen and in the tip of the valva, but because of the scarcity of material few dissections have been done and the significance of these differences remains to be determined. The nomenclature used for the male genitalia mostly follows Eliot (1973). An undescribed species, from Cape York Peninsula is smaller (male fore wing length 9 mm and 10 mm), the termen of the fore wing is straighter and the apex more pointed than in *P. arcana.* It has the processes of the uncus more widely separated than *P. arcana* and the ring formed by the vinculum is almost circular in anterior view. As only two males are known its description should await the collection of further males and the unknown female.



Figs 1-8. Upper and underside: (1, 5) holotype ♂ *P. arcana* **sp.n.**; (2, 6) paratype ♀ *P. arcana*; (3, 7) ♂ *P. illidgei* Waterhouse and Lyell, Burleigh Heads, Q.; (4, 8), ♀ *P. illidgei*, Goat Is., Brisbane R., Q.



Figs 9-16. Male genitalia. Odd numbers, holotype ♂ *P. arcana* **sp. n.**; even numbers, *P. illidgei* Waterhouse and Lyell: (9, 10) lateral view; (11, 12) dorsal view; (13, 14) valva in lateral view; (15, 16) tip of valva in dorsal view.



Figs 17-18. Fore, mid and hind legs: (17) *P. arcana* sp. n.; (18) *P. cuprea* Sands. All are left legs viewed from the outside.

In addition to the shape of the legs, *P. arcana* may be distinguished from *P. cuprea* Sands by the shape of the termen of both wings; this is a useful character in distinguishing all species of *Pseudodipsas* but difficult to describe. The upperside of males can be similar in colour to *P. cuprea* from southern Queensland but the copper areas are smaller and less conspicuous than in *P. cuprea* from Newcastle and further south. However, *P. arcana* has a narrower fore wing than *P. cuprea* and the markings beneath are broader and have broader white borders. The shape of the termen of the fore wing is more rounded than in *P. cuprea* from eastern Victoria, Sydney and localities north of Sydney, but less rounded than *P. cuprea* from the Central and Southern Tablelands of New South Wales. The status of these tableland populations of *P. cuprea* needs further investigation.

Set specimens of *P. arcana* tend to develop greasy marks as do related species.

P. arcana males have a strong tendency to hill-top and have been taken flying in company with males of *P. cuprea, P. b. brisbanensis* and *P. myrmecophila.* Nothing is known of the early stages. Adults have been taken in all months from September to April.

Key to the described Australian species of *Pseudodipsas* C. & R. Felder

1. Fore wing with veins R_5 and M_1 separated at base; beneath, ground colour white to pale brown 2

Fore wing with R_5 and M_1 shortly stalked; beneath, ground colour brown to grey-brown 3

2. Above, both sexes with an area of shining blue . . . . . . *cephenes* Hewitson

Above, both sexes without shining blue . . . . *eone* C. & R. Felder

3. Fore and hind femora swollen; mid tibia shorter than first tarsal segment of mid leg (Fig. 17) 4

Fore and hind femora not swollen; mid tibia longer than first tarsal segment of mid leg (Fig. 18) 5

4. Beneath, hind wing with postmedian band between CuA_1 and CuA_2 displaced basally by full width of band; female without shining blue above . . . . *arcana* sp. n.

Beneath, hind wing with postmedian band between CuA_1 and CuA_2 only slightly displaced; female with large areas of shining blue above . . . . *illidgei* Waterhouse & Lyell

5. Size small, fore wing length of male 9-10 mm, female 11-12 mm . . . . *myrmecophila* Waterhouse & Lyell

Larger, fore wing length of male 12-14 mm (rarely 11 mm), female 14-16 mm 6

6. Beneath, fore wing with postmedian band curved between R_5 and M_3 and conspicuously broken and displaced at M_3 . . . . *brisbanensis* Miskin

Beneath, fore wing with postmedian band straight between R_5 and M_3 and slightly displaced at M_3 . . . . *cuprea* Sands

Acknowledgements

We are grateful to Dr C. N. Smithers, Mr G. Daniels (both of the Australian Museum), Mr J. d'Apice, Mr R. Field, Prof. J. F. R. Kerr, Mr J. Macqueen, Mr M. S. Moulds and Mr I. G. Morhaus for lending specimens. We are also grateful to Mr S. P. Kim for the drawings, Mr J. Green for the photographs and Barbara Ranieri for typing the manuscript. Special thanks are due to Mr D. P. Sands whose work on this group has greatly aided the discrimination of new species.

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A NOTE ON *DROSOPHILA ALBOSTRIATA* MALLOCH (DIPTERA: DROSOPHILIDAE)

By Ian R. Bock

Dept. Genetics and Human Variation, La Trobe University, Bundoora, Vic. 3083.

Abstract

Drosophila albostriata Malloch is a rare endemic species previously known only from a few female specimens. The male genitalia are figured and additional distribution records given. The structure of the male genitalia suggests possible relationships with another endemic species, *D. fumida* Mather. *D. albostriata* has been collected in semi-arid areas, suggesting a greater resistance to heat and desiccation stresses than is usual amongst Australian *Drosophila* species.

Introduction

D. albostriata Malloch, 1924 is a particularly striking but nevertheless little-known endemic species of *Drosophila* hitherto recorded from only two localities in southern Queensland. The type locality is Eidsvold (25°32′S, 151°8′E). Further specimens have also been recorded from the vicinity of Glen Elgin Homestead (24°31′S, 149°11′E). The few specimens recorded to date have not included any males, and although the species is assigned to the subgenus *Scaptodrosophila* its systematic position within that large group has been regarded as obscure (Bock, 1976).

Through the courtesy of Prof. J. S. F. Barker (University of Sydney) and Mr G. B. Monteith (University of Queensland) I have obtained further specimens of *Drosophila albostriata* including several males. The male genitalia of this species are described and figured below and some further comments are offered on the distribution and possible relationships of the fly.

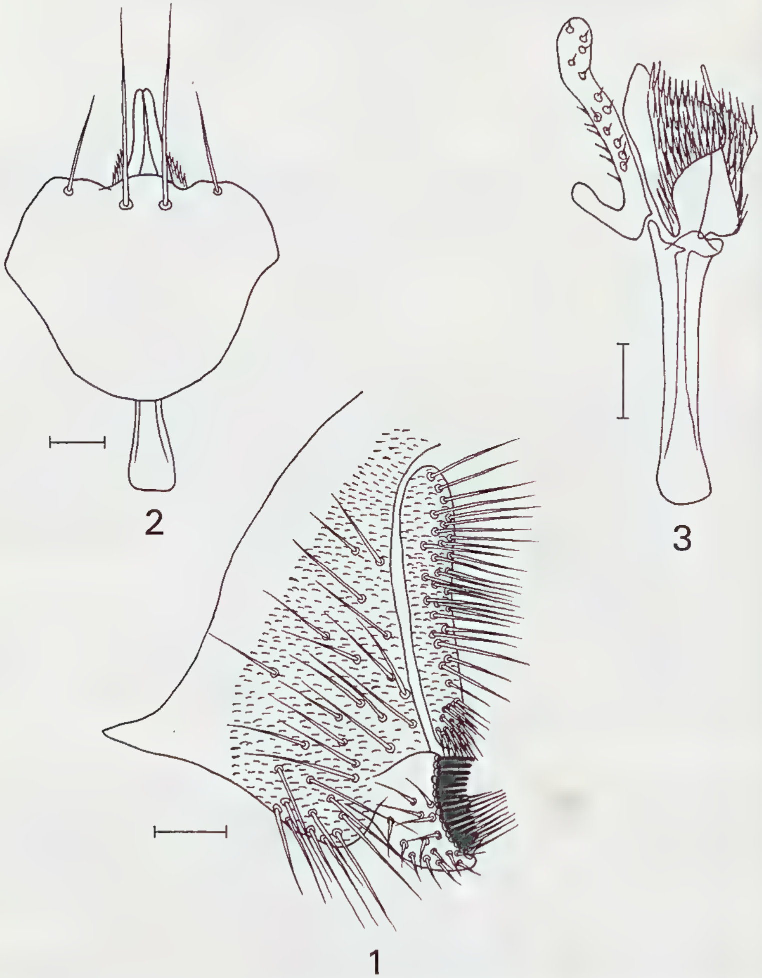
Male genitalia

External genitalia (Fig. 1). Anal plate narrow and elongate, with lower cluster of bristles differentiated from upper setation, and general micropubescence. Clasper with row of close elongate rounded black teeth along medial border and additional bristles on both inner and outer faces, but without micropubescence. Genital arch with numerous large bristles and micropubescence in medial half-two thirds. Lower lateral portion of genital arch elongated.

Internal genitalia (Figs 2, 3). Hypandrium with pair of large submedian spines and additional pair of smaller bristles lateral to these. Aedeagus bifid, laterally compressed, apically rounded and expanded, with numerous spine-like protuberances. Aedeagal apodeme straight. Parandrites large, articulated to aedeagus, strongly sclerotized, elongate, with numerous very fine sensilla.

Further records

QUEENSLAND: 1♂, Caloundra (26°8′S, 153°10′E), 28.viii.1929, F. A. Perkins (University of Queensland, Entomology Department collection). 2♂, 5♀, Glen Elgin HS, 18.xi.1977, attracted to banana bait in vicinity of *Opuntia* stands J. S. F. Barker; 1♀, Planet Downs HS (24°32′S, 148°53′E), 18.xi.1977, J. S. F. Barker; 5♀, Theodore (24°57′S, 150°05′E), 26.xi.1977, J. S. F. Barker (La Trobe University, Department of Genetics & Human Variation collection).



Figs 1-3. *D. albostriata*, male genitalia: (1) external genitalia; (2) hypandrium; (3) aedeagus and parandrite. Scales 50 μ.

Discussion

The Australian *Drosophila* fauna is now known to comprise almost 100 species, or about 7% of the described world total. The four major subgenera of *Drosophila* (*Drosophila*, *Sophophora*, *Hirtodrosophila* and *Scaptodrosophila*) are represented amongst the fauna; ancestral forms of the subgenus *Scaptodrosophila*, which has speciated most widely and contains the majority of the Australian species, were presumably amongst the earliest drosophilid invaders of Australia.

Several clearly defined species groups are recognizable amongst the Australian *Scaptodrosophila* fauna (Bock and Parsons, 1978), while other species are too poorly known, or appear to be too aberrant, to permit recognition of their closest affinities. *D. albostriata* is unique amongst the Australian species in its coloration, black with two conspicuous longitudinal white stripes along the mesonotum, continued on the head along the orbital borders. Although the species is included in *Scaptodrosophila,* it is unusual in possessing very small prescutellar bristles and a minute middle sternopleural bristle (large prescutellars and large middle sternopleurals are present in most members of the subgenus). *D. albostriata* may thus not be realted to any other species by coloration, but in the bristle reductions it is similar to *D. fumida* Mather. The latter species is widespread in southern Australia and occurs in both the eastern and western parts of the continent; it is distinguished, apart from its unusually small prescutellars and middle sternopleurals, by possession of patterened wings.

Superficially, *D. albostriata* and *D. fumida* thus appear to be quite dissimilar, but apart from the bristle reductions mentioned above, the male genitalia of *D. albostriata* are rather similar to those of *D. fumida* (Figs 79 and 80 in Bock, 1976). The most striking resemblances are in the external genitalia: the anal plates and the claspers are very similar, and the same unusual narrow extension in the lower lateral part of the genital arch is evident in both species. In the internal genitalia, the hypandrium of both species possesses more than the usual two large bristles and the parandrites of both species are very large, although the aedeagi of the two species are dissimilar. It is thus possible that, colour and pattern notwithstanding, *D. albostriata* and *D. fumida* share relatively recent ancestry, although both species are so unlike any others that further comments on their possible relationships would be highly speculative.

D. albostriata is quite unusual in a further respect. Endemic (and, in most cases, introduced) species of *Drosophila* in Australia are very rarely found under conditions of high temperature/desiccation stress. Some species have adapted to open forests, but on hot dry days the latter species are almost invariably only found in the immediate vicinity of creeks where desiccation stress is demonstrably lower (Parsons, 1975). Eidsvold, Theodore, and Glen Elgin and Planet Downs Homesteads both lie in a region of dry sclerophyll forest where summer temperatures are extreme, and indeed few native drosophilids are found (Barker, pers. comm.). It appears that *D. albostriata* may have adapted physiologically to climatic conditions beyond the tolerance range of that of most other Australian Drosophilidae. However, as for most other species of the latter, the natural history of *D. albostriata*, particularly the resources exploited by the larvae, remains unknown.

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Parsons, P. A., 1975. The effect of temperature and humidity on the distribution patterns of *Drosophila inornata* in Victoria, Australia. *Environ. Ent.* 4: 961-964.

BOOK REVIEW

The Lepidoptera of Norfolk Island, their biogeography and ecology by J. D. Holloway. W. Junk, The Hague. Series Entomologica, Vol. 13. 8vo. 291 pp., 140 text-figs, 21 pls. 1977. Price about $40.00

This book is made up of twelve chapters, an appendix and two indices, one to subject and one taxonomic, in addition to an introductory section and a list of references.

The introduction is mainly an acknowledgement of help and the first two chapters cover the main features of climate, geology and soils of Norfolk Island. Chapter III puts the book into historical perspective and gives some essential background on the flora. Chapter IV prepares the reader for what is to follow by discussing the sampling technique, programme and areas sampled. Chapter V gives a systematic treatment of the Lepidoptera. Chapters VI to XI form the more generally interesting part of the book and deal with such topics as the vagrancy of the Norfolk species, their biogeography, seasonal patterns and the ecological diversity of the moth fauna.

The book is full of new information on the moths of this island and several new species are described. Many taxonomists would prefer to see new species described elsewhere, rather than in a book of this nature. One remarkable suggestion is that "perhaps half the species recorded are wholly or partially vagrant". This is concluded from comparison of number of species recorded compared with a theoretical expected number derived from data on size of islands. Criteria are given for determining which species are probably vagrant. I am not certain of the validity of some of the criteria but I leave the reader to consider these for himself. The ecological diversity of the island is considerable despite its small size and stems from interference and subsequent partial regeneration of native flora. This could, undoubtedly, lead to a higher than expected number of species. There is little doubt that there has been much inadvertant introduction by man and evidence for a fairly high rate of natural introduction is given in Chapter VI (p. 150 *et seq.*). Introduction of potential host plants has been high. It is not clearly stated what the author considers the difference to be between vagrants and partial vagrants; if the latter refers to reinforcement of an established population by periodic introduction then the number of vagrant species is, of course, much reduced and "partial vagrants" are seen to be resident, as species.

The conclusions reached on the relationships of the moth fauna and the data on local distribution patterns are interesting. The remarkable amount of work done in collecting and sorting material must surely make the moth fauna of Norfolk Island one of the best known of any island of comparable size; most of the larger forms must now be recorded.

The information in this book will form a sound base line for measuring the actual rate of colonization of the island by the larger species and this will permit future testing of the hypothesis that vagrancy rate is high.

As a study of a discrete faunal group, over a small isolated area, the work is outstanding. The overall review of the insect fauna of the island given in the Appendix is a useful summary for anyone interested in the general composition of the fauna, although, of course, few groups have been collected to the same degree as the Lepidoptera and the lists are derived from literature and collections which have not been fully studied.

The book is appropriately dedicated to Maurge and Freddie Jowett and it is a record of their remarkable enthusiasm and dedication. Through their efforts we now know a great deal about the Norfolk Island moth fauna and the basis has been provided to develop and test techniques which have much wider implications for zoogeographers and ecologists.

One major importance of this book lies in its example, which extends well beyond the restricted audience of Lepidopterists. It is unfortunate that the high price will probably result in most readers using a lending library copy rather than keeping a copy on their own shelves.

C. N. SMITHERS
Australian Museum, Sydney

ESTABLISHMENT OF *VESPULA GERMANICA* (FABRICIUS) (HYMENOPTERA: VESPIDAE) IN NEW SOUTH WALES

By C. N. Smithers and G. A. Holloway
The Australian Museum, Sydney

Abstract

The establishment of *Vespula germanica* (Fab.) in the Sydney area is confirmed and its distribution given. Its status in New Zealand and its potential economic importance in Australia are indicated.

Smithers and Holloway (1977) recorded two worker specimens of the European wasp, *Vespula germanica* (Fab.) from Sydney. The discovery of these specimens, in June 1975 and February 1977, led to an attempt to ascertain whether the species was established and breeding. This paper reports on nests discovered in the Sydney area and briefly summarizes the status of the species in some other areas which it has colonised.

Western Australia:– A few nests of *V. germanica* were found within an 8 km radius of Fremantle in 1977 (Anonymous 1977). It is believed that these were destroyed; no further reports have been published.

Tasmania:– *V. germanica* was first found in Hobart in 1959; it is now known to be widespread in Tasmania where it is considered the most troublesome outdoor pest in urban situations; robbing of bee hives has been reported Anonymous (1975).

New Zealand:– Thomas (1960) discussed the introduction, spread, seasonal activity, colony development and economic significance of the species in New Zealand where it was first found at Te Rapa in 1945. By 1952 it was known to occur over much of North Island. Fordham (1962) recorded it as being present in Christchurch (South Island) by 1952 and widespread in New Zealand by 1962. It was responsible, by 1952, for some damage to fruit in orchards and vineyards and had been noted as destroying colonies of bees in apiaries as well as being a nuisance through stinging. It was subsequently considered to be of sufficient economic importance for serious attempts to be made to devise control measures (e.g. Perrott 1975). Walton and Reid (1976) have published results of a survey carried out during the 1974/75 season which revealed that 1.9% of bee colonies (3,900 hives) in commercial and semicommercial apiaries were destroyed and 4.9% (10,000 hives) seriously affected. The damage was estimated to involve a loss of some $134,000, not including costs of searching for and destroying nests nor preventative measures taken in apiaries and honey houses. During the same period American Foul Brood disease destroyed 0.44% of bee colonies.

New South Wales:– Active nests so far discovered in the Sydney area are listed in Table I. All except one (Mosman) are south of the Parramatta River and Port Jackson; most are in the George's River area. This indicates occupation of an area at least from just south of the George's River to just north of Sydney Harbour. The known nest distribution (Fig. 1) suggests a concentration of the population near the George's River (which might represent the area of original establishment), with lower populations elsewhere (possibly indicating the zone into which the species has spread). This indication of distribution, however, may be false as discovery of the first nest in Oatley received publicity in the local press in that and

Fig. 1. Distribution of confirmed nests and sightings of individuals of *Vespula germanica* in the Sydney area.

adjacent suburbs which led to many residents reporting the nests of various species of wasps, amongst which were the nests of *V. germanica.*

Table II lists confirmed records of individuals, including the two previously recorded specimens (marked by an asterisk). Their distribution pattern follows closely that of the known distribution of nests except for the Turramurra specimen which may have been a direct introduction from New Zealand (Smithers & Holloway 1977). A baited trap in that area did not attract more specimens.

Most nests have been found in protected situations (see Table I); this is usual for this species in Europe but in New Zealand some large colonies have developed in more open places and some have continued to be active through winter to produce excessively large colonies. The European colonies usually die out in winter after producing fertile queens which hibernate and emerge to found new colonies in spring. The cycle under Sydney conditions is not known but one hibernating queen has been found under a piece of timber (at Gymea) and one colony is known to have died out naturally with the onset of cold weather (Hyde Park). At the time of writing (July 1978) foraging activity by workers which was obvious in Hyde Park appears to have ceased.

These observations suggest that some colonies at least, are following the typical European activity cycle.

Descriptions of *V. germanica* and a discussion of its biology are given in Spradbury (1973) and Thomas (1960). A typical carton nest, after removal from a cavity in a palm tree, is shown in Fig. 2.

We are anxious to obtain all available records of the occurrence of *V. germanica* and will be pleased to confirm identification of specimens.

Discussion

Although there are no reports as yet from Australia of serious economic impact by *V. germanica* the experience in New Zealand is probably a good indication of what might be expected to occur here in future. Large numbers

TABLE I

Locality	Date	Observer	Nest site
Oyster Bay	May 1978	N. Campbell	Nest in tree stump, 1 m. This subsequently knocked to ground. Small nest started on ground below site of old nest.
Oyster Bay	April 1978	G. Coleman	Nest in ground. Fumigated and removed.
Kareela	May 1978	G. Prosser	Nest in ground below sandstone rock. Destroyed by fire.
Kareela	April 1978	M. Brennan	Nest in ground. Removed by fire.
Oatley West	April 1978	Ms Dyer	Nest in ground below sandstone rock. Fumigated.
Oatley	March 1978	J. Keating	Nest behind sandstone retaining wall in soil. Fumigated and removed.
Peakhurst	March 1978	Mr Bastsch	Nest 6 m above ground level in longicorn damage of *Eucalyptus* sp. (Adult wasps removed in flight by 2 Spangled Drongos and nest removed by 2 Galahs.
Woronora	April 1978	B. Crouch	Nest situated in ground between 2 sandstone rocks. Destroyed by fire.
Sylvania Waters	March 1978	J. McGann	Nest in house wall cavity. Destroyed by fumigation.
Taren Point	March 1978	Mrs Keen	Nest in cavity ceiling of shed.
Padstow	May 1978	R. Taylor	Nest behind fascia board in roof of house.
Hurstville	May 1978	D. Armstrong	Nest in earthen bank behind brick retaining wall. Destroyed by fumigation.
Enfield	April 1978	Mrs McKinnon	Small nest in carpet roll in garage. Destroyed by fumigation.
Enfield	April 1978	Mrs McKinnon	Nest in brick gate post.
Drummoyne	May 1978	A. Dibley	Nest in wall cavity of house.
Hyde Park	March 1978	C. Smithers	Nest in cavity between the frond bases of the palm *Phoenix caniensis.* Removed on 21 June after desertion of the nest by the wasps. An older nest in the open approx. 0.6 m lower than above nest had been knocked down at some earlier date.
Mosman	May 1978	Mrs Parie	Nest in palm, *Phoenix caniensis.* Removed.

TABLE II

Records of individuals of *V. germanica* in Sydney area

Locality	Date	Observer	Remarks
Kirrawee	March 1978	Mrs Biddolph	1 worker captured.
Kirrawee	April 1978	Mr Williamson	5 - 6 adults flying around flowers of banana tree.
Oyster Bay	March 1978	Mrs Harkness	3 workers observed on grapefruit tree.
Oyster Bay	May 1978	Mrs Mathews	1 worker captured
Lugarno	March 1978	Mrs Clark	1 worker captured
Oatley	March 1978	M. Rock	Several adults flying
Oatley	March 1978	P. Newbury	Large numbers of wasps observed flying around beehives.
Gymea	June 1978	W. Wilson	1 queen hibernating under timber
*William St, Sydney	June 1975	D.K. McAlpine	1 worker found dead on pavement
*Turramurra	Feb. 1978	A.S. Smithers	1 worker in house

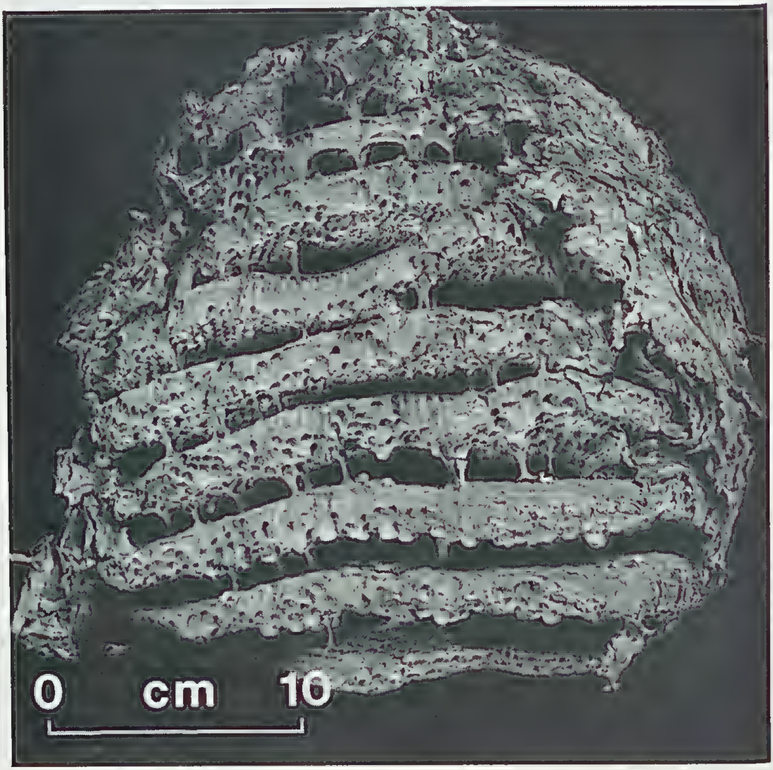

Fig. 2. Carton nest of *Vespula germanica* after removal from cavity in palm tree, showing tiers of cells joined by narrow columns. Outer covering of nest partly removed.

have already been observed in the vicinity of one apiary at Oatley. Apart from any direct economically undesirable activities, *V. germanica* is a predatory species, feeding its larvae on insects and although it may take pest species as part of its food any suggestions that it may be a "beneficial" insect are based on an unwarranted oversimplification of ecological systems and are not valid; the arrival of such a pugnacious, persistent, numerous and general predator into Australian ecosystems is an unfortunate event.

Acknowledgements

We would like to thank Dr R. J. Hardy, Dr E. W. Valentine and Dr K. Richards for information on *V. germanica* in Tasmania, New Zealand and Western Australia, Mr M. Casimir for making field assistance available, Dr B. Dominiac for help in the field, Dr K. Lindsey for arranging for records to be provided to the Museum, Mr John Fields for the photograph and Ms L. Lawrie for providing fumigant materials. The observers responsible for reporting nest and specimens on which this note is based are thanked for their cooperation.

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BOOK REVIEW

Standard names for common insects of New Zealand: compiled by a committee under the chairmanship of D. N. Ferro. 1977. Entomological Society of N.Z. 42 pages. Price NZ$2.00. Available from the Society, c/- Mrs B.M. May, 60 Ocean View Rd, Huia, N.Z.

The primary purpose of this book is summarised in its preface: ". . . to standardise those common names of economically important terrestrial invertebrates and other species commonly encountered." As Bulletin No. 4 of the Society it replaces an interim list published in 1967 and is the counterpart of our Australian list (C.S.I.R.O. Bulletin No. 287).

Almost 1,000 names are included which are listed alphabetically in two sections, one by latin to common name, the other by common to latin name. Each is accompanyed by author citation and in the latin to common name section also by family and order. Common synonyms are cross referenced which adds to the value of the list.

I feel it is somewhat unfortunate that all hyphens have been omitted from the common names. Some rather unnatural words result; "New Zealand glowworm", "lightbrown apple moth" and "squareended cobweb spiders" are some examples. In other cases words have been separated but the decision to either join or separate does not appear to be consistant; on p. 24, for example, there is "big jawed orbweb spiders" followed by "bigheaded ant".

Many of the species included in the book have, at present, several commonly used names. By establishing this list a standard for communication is provided. For those working with New Zealand insects this book is a must; for others a useful asset.

Robert Lachlan

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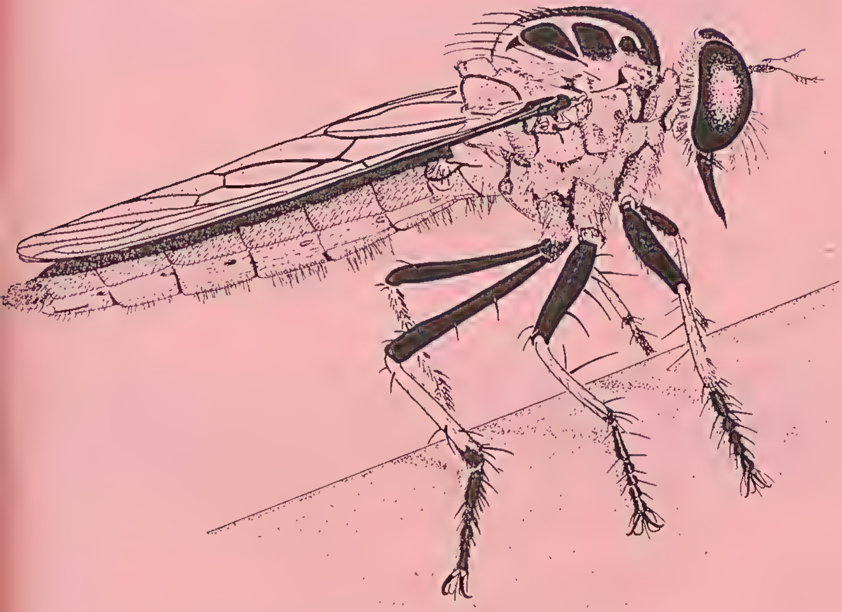

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COVER

Illustrated by Greg Daniels.

Depicts the Australian robber fly, *Ommatius angustiventris* Macquart, a common species found throughout the east coast from central Queensland to eastern Victoria. One of the few Australian Asilidae that has adapted to suburban gardens, its larvae are found in rich loamy soils. The adults prey on insects of many orders and usually catch them in flight.

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A NEW SPECIES OF CYPSELOSOMATIDAE FROM LORD HOWE ISLAND (DIPTERA, MICROPEZOIDEA)

By David K. McAlpine
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Abstract

A new species of *Cypselosoma* is described from Lord Howe Island, New South Wales. Some of its unusual characters necessitate a revision of the means of differentiating the two known genera of Cypselosomatidae.

Introduction

The Cypselosomatidae are a very small Oriental and Australian family of acalyptrate flies with about five previously recognized species (see McAlpine, 1966, for discussion of relationships, summary of records, and references). Further information on relationships in the Micropezoidea is given by Griffiths (1972) and McAlpine (1975). Hennig (1971) mentions a species of *Cypselosoma* from Nepal.

I maintain the Pseudopomyzidae and Cypselosomatidae as separate families because the characters they have in common appear to be symplesiomorphic in relation to those of other Micropezoidea or are of unknown phylogenetic significance (e.g. the reduction of certain wing-veins so commonly found among acalyptrate flies), and because there is a possibility that they may not be more closely related to each other than at least one of them is to some other members of Micropezoidea. The Pseudopomyzidae seem too uniform structurally, e.g. in antennal structure and shape of the second basal cell, to allow the probability that they are polyphyletic.

Lord Howe Island is situated almost 200 km from the east coast of Australia. Its terrestrial flora and fauna are largely oceanic, having reached the island by dispersal over the sea. While not rich in species they include some interesting endemics. For a summary of the natural history of the island see Smith (1974). The new species here described was found in the stunted, mossy rainforest on the summit of Mount Gower. This area is inhabited by some of the rarer organisms endemic to the island, including the woodhen, *Tricholimnas sylvestris* (Sclater), and the gesneriaceous tree, *Negria rhabdothamnoides* F. Muell. (see Green, 1973).

The occurrence on Lord Howe Island of a member of the Cypselosomatidae which, while very distinctive, is related to the cavernicolous Australian mainland species, indicates that the family has been present in the Australian region long enough to develop some distinctive forms, i.e. probably since well before the close of the Tertiary.

Cypselosoma disneyi n. sp.

Fig. 1

FEMALE

Coloration. Head black; postgena dark brown; face, parafacial,and upper part of cheek bordering eye yellowish brown. Antenna yellowish brown, suffused with blackish brown on dorsal surface of segments. Prelabrum blackish; palpus and proboscis pale, dull yellowish. Thorax black, rather shining, suffused with yellowish brown on lateral parts of mesoscutum and upper part of mesopleuron; sternopleuron with yellowish patch on desclerotized area of upper margin. Legs black; fore leg with only tarsal segment 1 paler, creamy white; mid and hind legs with coxa, trochanter, and base of femur pale yellowish, with tarsus pale yellowish having 2 distal segments (mid tarsus) or 3 distal segments (hind tarsus) brown. Wing with 3 dark grey somewhat nebulous marks, one apical, one forming an irregular transverse band between anterior and discal crossveins, and one forming a blotch on anterior part of wing limited on basal side by termination of vein 1 and fork of veins 2 + 3. Haltere pale yellowish; capitellum blackish with white tip. Abdominal tergites and ovipositor sheath blackish; compound tergite 1 + 2 with large pale yellowish transverse central mark.

Head a little more depressed than in *C. australe*, but not markedly flattened as in the genus *Formicosepsis*; height of cheek about 0.2 of height of eye; eye oblique, slightly longer than high; cephalic chaetotaxy as in *C. australe*. Antennal segment 3 smaller than in *C. australe.*

Thorax slightly more depressed and more slender than in *C. australe*; scutellum small and convex, with bristles of discal pair only slightly more widely separated than those of apical pair; the following bristles present: 4 pairs of strong dorsocentrals, the foremost with a minute setula in front in addition to a short scapular bristle just above pronotum; acrostichals one pair only, situated well in front of suture; humeral; 2 notopleurals; presutural; 2 supra-alars (or supra-alar and postalar); a pair of strong apical scutellars and a pair of much shorter but fairly stout discal scutellars. Fore femur with rather long preapical posteroventral bristle, a series of posteroventral setulae extending from this bristle almost to base, and a series of rather short but strong anteroventral spines on distal half; mid femur with 4 or 5 strong anteroventral bristles mounted on a tubercle; mid tibia with 3 anterodorsal bristles, 3 strong posterodorsal bristles and a very short basal one, 2 anteroventral bristles, one preapical ventral bristle, and several much shorter bristles at and near apex; other tibiae unarmed. Wing structurally very similar to that of *C. australe*; second costal cell and whole of first basal cell microtrichose.

Abdomen narrowly ovoid; ovipositor sheath subconical, slightly swollen basally; tergite 2 with small dense tuft of setulae on each side.

Dimensions: total length 4.2 mm; lenght of thorax 2.0 mm; length of wing 2.9 mm.

Holotype ♀ (unique): Mount Gower, Lord Howe Island, New South Wales (summit area), 15.iii.1978 (Australian Museum), H. J. de S. Disney.

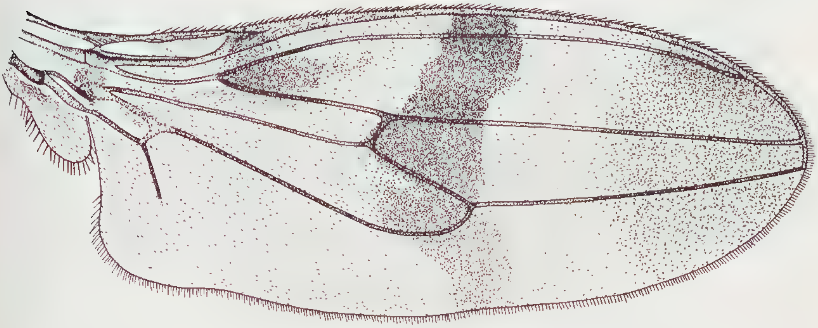

Fig. 1. *Cypselosoma disneyi*, wing.

Comparative notes

C. disneyi differs from the two other species of the genus in its more slender habitus, in having the eye longer than high, in the very narrow cheek, in having only four pairs of dorsocentral bristles and a single (anterior) pair of acrostichal bristles, and in having conspicuous dark markings on the wing. Some of these characters are more typical of the allied genus *Formicosepsis* than of *Cypselosoma* according to the key previously given by me (McAlpine, 1966), though in the structure of wing and prothorax there is no approach to *Formicosepsis*.

Previously (McAlpine, 1966: 675) I tabulated 14 character differences between *C. gephyrae* and *C. australis* (correctly *C. australe*). Excluding three characters restricted to the male sex, unknown for *C. disneyi*, the new species disagrees with *C. gephyrae* in all characters tabulated and agrees, except as follows, with characters tabulated for *C. australe*: acrostichal bristles reduced to a single anterior pair (two anterior pairs in *C. australe*, six pairs in a complete series in *C. gephyrae*); mid tibia with one more anterodorsal bristle (total three) than in *C. australe*.

Despite its aberrant features, *C. disneyi* resembles *C. australe* much more closely than it does any other member of the Cypselosomatidae, and I conclude that there is close relationship between the two species. This accords with geographical data, for *C. australe* lives on the nearest part of the Australian mainland to the island habitat of *C. disneyi* at almost identical latitude.

The key to genera of Cypselosomatidae must be modified as follows to accommodate the characters of the new species:—

KEY TO GENERA OF CYPSELOSOMATIDAE

1. Prothorax very prominent, neck-like; wing much narrowed basally, with vein 6 vestigial beyond anal cell and alula reduced; apex of scutellum directed vertically upwards . . . . *Formicosepsis*

— Prothorax short and inconspicuous; wing not narrowed basally, with vein 6 distinct and alula broad; apex of scutellum directed posteriorly . . . . *Cypselosoma*

Acknowledgements

I am indebted to Mr H. J. de S. Disney for collecting and preserving this interesting insect and to Miss M. A. Schneider for preparing the illustration.

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Aust. ent. Mag. 5(4), November, 1978

A NEW SPECIES OF *PARALUCIA* WATERHOUSE AND TURNER FROM NEW SOUTH WALES (LEPIDOPTERA: LYCAENIDAE)

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Abstract

Paralucia spinifera sp. n. is described, figured and compared with other species of *Paralucia*. The early stages are also described.

Introduction

A single female of an undescribed species of *Paralucia* Waterhouse and Turner was taken on 28 October 1964 near Bathurst, N.S.W. by I. F. B. Common and M. S. Upton, and was mentioned by Common and Waterhouse (1972). Despite many searches the species was not rediscovered until 25 October 1977, when three males and two females, as well as eggs, were taken very near the spot where the earlier specimen originated. A larva which hatched from one of the eggs was reared to the pupal stage in the laboratory. Although this species is less conspicuous than the other two species of *Paralucia*, it is remarkable that it should have remained undiscovered for so long.

Paralucia spinifera sp. n. (Figs 1-6, 8-10, 13)

Types:– Holotype ♂ labelled "33.27S 149.48E, 20 km E of Bathurst, N.S.W., 1000 m, 25.Oct.1977, E. D. Edwards", Reg. No. 3292, in Australian National Insect Collection. *Paratypes*, 2♂ 3♀; 2♂ 2♀ with same label data as holotype (1♂ 1♀ genitalia tube No. 196 and 199 respectively, 1♀ genitalia slide M502); 1♀ labelled "10 mls E of Bathurst, N.S.W., 2800 ft, 28.Oct.1964, I. F. B. Common and M. S. Upton"; all in Australian National Insect Collection. A preserved egg and larva, as well as a living pupa, are excluded from the paratypic series.

Distribution:– The species is known only from a small area 16 to 20 km E of Bathurst, New South Wales, at an altitude of about 1000 m.

Description:– Male (Figs 1, 3). Head black with some white scales; frons black with narrow central and marginal white bars; antennae shining black, ringed with white; club black above, beneath shining white towards base and black towards tip with posterior surface unscaled; labial palpi black above, beneath second segment white with occasional grey scales, terminal segment grey. Thorax black above with pale grey hair-scales, pale grey beneath. Legs grey-brown above, white beneath; fore tibia with long terminal spine; mid tibia shorter than first tarsal segment. Abdomen black above, pale grey beneath; tip with some pale grey scales. Fore wing: costa strongly arched near base, then straight; termen evenly rounded; above shining purple with broad black costal and terminal margins, black bar at end of cell; veins narrowly black; a row of very small subterminal pale blue spots midway between veins from R_5 to CuA_1; cilia black, white-tipped between veins; beneath grey-brown; base speckled with white scales; bands dark brown margined with white; small subbasal band in cell; submedian band from R_2 to 1A + 2A, sections between R_2 and R_3 and between CuA_1 and CuA_2 displaced distally; median band at end of cell from R_3 to M_3; postmedian band from R_3 to 1A + 2A, speckled with white scales, section between M_1 and M_3 displaced distally; subterminal area with speckling of white and brown scales forming a poorly defined crenulate line; termen brown; cilia grey-brown, white-tipped between veins. Hind wing: termen rounded; tornus somewhat produced; above shining purple with broad black costal, terminal and inner margins; veins narrowly black; a row of small subterminal pale blue spots between veins from M_1 to inner margin; base with long silvery hair-scales; cilia black, white-tipped between veins; beneath grey-brown, with scattered pale bronze scales in disc and towards tornus and scattered white scales towards costa, termen and inner margin; bands dark brown margined with white, subbasal band from Sc + R_1 to 1A + 2A poorly defined, submedian band with sections widely spaced from Sc + R_1 to 1A + 2A, sections between CuA_1 and 1A + 2A displaced distally, median band at end of cell extending from M_1 to M_3, postmedian band from costa to inner margin, sections between M_3 and CuA_2 broader than remainder, sections displaced distally between CuA_1 and CuA_2 and proximally from Sc + R_1 to M_1 and from 1A + 2A to inner margin, scattered brown and white scales forming an indistinct subterminal line; termen grey-brown; cilia grey-brown, white-tipped between veins. Fore wing length 10-11 mm.

Male genitalia (Fig. 9). Tegumen and uncus strongly arched above vinculum; uncus produced into a pair of pointed processes, posterior margin rounded; valva narrow, strongly curved, tip slightly hooked; juxta Y-shaped, lightly sclerotized; aedeagus curved, broad at base, much narrower distally, distal orifice oblique.

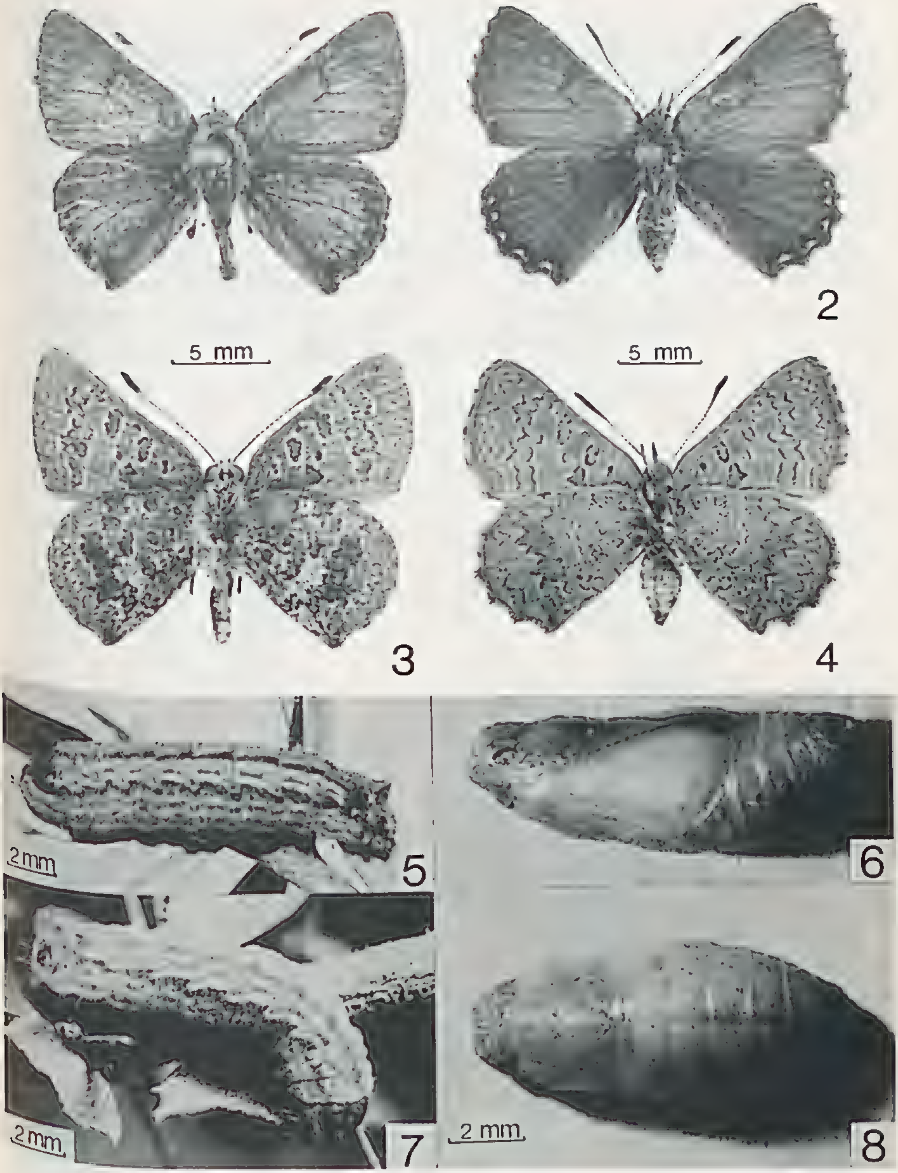
Female (Figs 2, 4). Head, thorax and abdomen as in male except that shining white scales at base of antennal club are absent in some specimens, tip of abdomen without pale grey scales. Fore wing: termen evenly rounded; above dark brown, discal area dark brown sometimes with shining bronze scales; veins dark brown; base with a few scattered blue scales; a row of very small subterminal pale blue spots sometimes present between veins from M_2 to 1A + 2A; cilia dark brown white-tipped between veins; beneath pale brown; markings brown, edged with white; markings as in male. Hind wing: termen slightly produced at the veins; above dark brown, paler in disc; scattered blue scales at base; a row of subterminal pale blue spots between veins from M_1 to 1A + 2A; inner margin brown; base with long grey hair-scales; cilia dark brown, white-tipped between veins; beneath pale brown, sometimes with scattered bronze or mauve scales; markings brown similar to male. Length of fore wing 11-12 mm.

Female genitalia (Fig. 10). Corpus bursae simple; basal part of ductus bursae sclerotized on ventral surface and bent to a right angle ventrally; a narrow band of sclerotization on posterior margin of dorsal wall of sinus vaginalis; another narrow band of sclerotization on the lateral walls of the sinus vaginalis meeting ventral to the ostium.

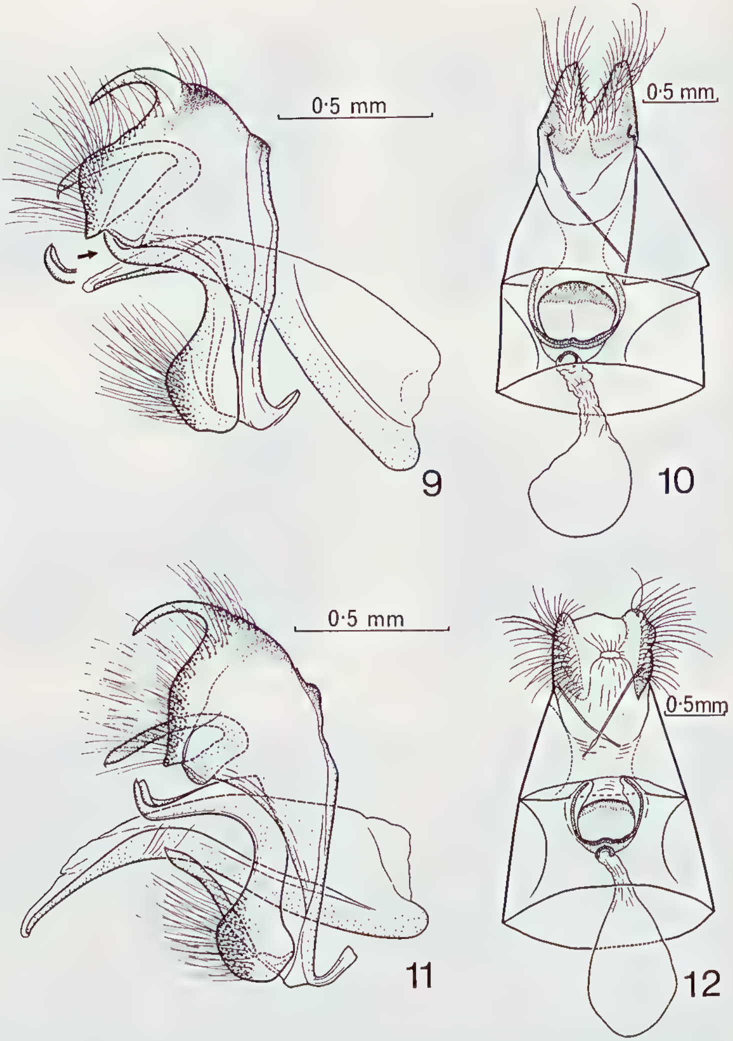
Life history:– Egg. Hemispherical, pale green at first, later pale cream; micropyle deeply depressed, with dense fine pits separated by ridges produced to short points where ridges intersect. Diameter 0.8 mm, height 0.4 mm. One egg preserved in the Australian National Insect Collection, tube No. 2935.

First instar larva. Cream with brown dorsal, subdorsal and lateral lines; prothoracic and anal plates shining black. Head hidden; thorax and abdomen with primary setae black, some long and tapering, others short and bluntly tipped. Length 2.5 mm.

Fifth (final) instar larva (Fig. 5). Head dark brown; prothoracic segment grey with lateral white and reddish brown lines; prothoracic plate mottled dull brown-black; thoracic segments with lateral setae colourless, dorsal and lateral surfaces densely covered with short secondary setae pale in colour but dark above dorsal and subdorsal lines; mesothoracic, metathoracic and abdominal segments grey with brown dorsal and subdorsal lines, subdorsal line angled laterally towards rear of each segment, lateral line greyish brown with reddish brown line between lateral and subdorsal lines, grey beneath; spiracles brown; abdominal segments 4 to 7 with dorsal setae prominent, short and black; dorsal and lateral surfaces densely covered with short secondary setae pale in colour but dark brown above dorsal and subdorsal line; abdominal segment 8 with prominent dorsolateral projections bearing eversible organs which are usually everted; anal segment grey; anal plate mottled dull brown-black. Length 14 mm. One final instar larva preserved in the Australian National Insect Collection tube No. 2936.



Figs 1-8. (1) upperside holotype ♂ *P. spinifera* sp. n.; (2, 4) upper and underside paratype ♀ *P. spinifera* sp. n.; (3) underside paratype ♂ *P. spinifera* sp. n.; (5) final instar larva *P. spinifera* sp. n.; (6, 8) lateral and dorsal view of pupa *P. spinifera* sp. n.; (7) final instar larva *P. aurifera.*



Figs 9-12. (9, 11) lateral view of male genitalia; (9) *P. spinifera* sp.n.; (11) *P. aurifera*; (10, 12) ventral view of female genitalia; (10) *P. spinifera* sp.n.; (12) *P. aurifera*.

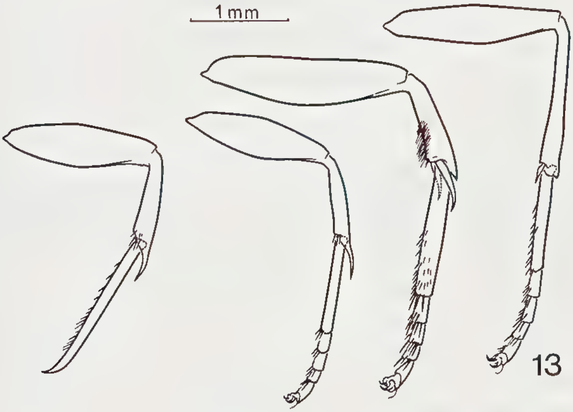
Pupa (Figs 6, 8). Head and thorax brown; abdomen pale greenish brown with grey dorsal line on abdominal segments 4 to 6; with thinly scattered brown dots particularly on wings; distinctly blackened antennae; spiracles pale brown; surface of cuticle roughened, particularly on head and covered with minute raised dots; a few anal hooks present but without central girdle. Length 10 mm, width 4 mm.

Foodplant:– *Bursaria spinosa* Cav. (Pittosporaceae).

Discussion

The number of pale blue spots varies in the fore wings of both sexes of *Paralucia spinifera* and they may be absent in the fore wing of the female. The available specimens are too worn to determine variation of the pattern beneath. The markings on the undersides of the hind wings are sometimes dark brown instead of brown.

Paralucia spinifera differs from *P. aurifera* (Blanchard) and *P. pyrodiscus* (Rosenstock) in having the tip of each fore tibia, in both sexes, produced as a conspicuous, non-articulated, spine-like process that extends over the base of the tarsus (Figs 13, 14). The tip of the mid tibia is also slightly produced and has the normal pair of articulated apical spurs. In both *P. spinifera* and *P. aurifera* the tibia of the mid leg is shorter than the first tarsal segment but in *P. pyrodiscus* the mid tibia is slightly longer than the first tarsal segment.



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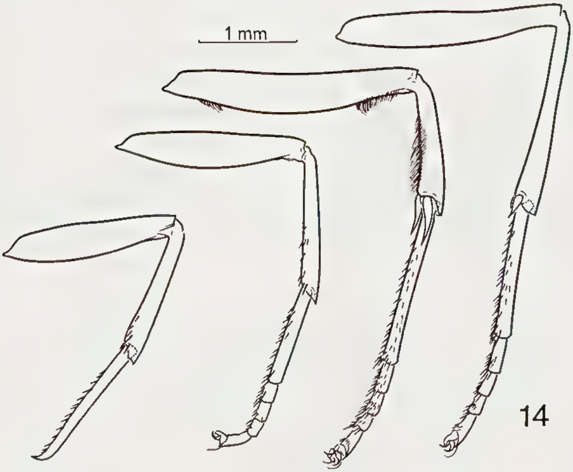

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Figs 13, 14. Male fore leg and female fore, mid and hind legs: (13) *P. spinifera* sp. n.; (14) *P. aurifera*. All are left legs viewed from the outside.

In the male of *P. spinifera* the apex of the fore wing is less acute, the termen more rounded and the tornus of the hind wing less produced than in the other species. The copper areas above in the other species are replaced in *P. spinifera* by shining purple in the male and dark brown in the female. The markings beneath are similar but larger and darker in *P. spinifera.*

As in other *Paralucia* the male genitalia of *P. spinifera* have the upswept tegumen, which raises the processes of the uncus above the peak of the vinculum. They differ from *P. aurifera* (Fig. 11) and *P. pyrodiscus*, which have closely similar genitalia, by the more rounded posterior margin of the uncus in lateral view and the lightly sclerotized juxta. The female genitalia of *P. spinifera* and *P. aurifera* are also similar.

The larva and pupa of *P. spinifera* resemble those of *P. aurifera* (larva, Fig. 7) and could not be distinguished on their colour, shape or on the form of the secondary setae. The larva of *P. pyrodiscus* is paler in colour and the markings are less conspicuous. The larvae of all three feed on *Bursaria spinosa.* The pupa of *P. pyrodiscus* is yellowish brown.

Adult males flew rapidly at about 1 m from the ground and rested with wings half open on dead twigs of the foodplant. While resting they could easily be mistaken for large specimens of *Neolucia agricola* (Westwood). Females flew close to the ground near the foodplant and less rapidly than the males. Neither *P. aurifera* nor *P. pyrodiscus* has been taken flying with *P. spinifera.*

Eggs were laid singly on the upper surfaces of fully expanded leaves or on stems of young shoots of the foodplant. Small black ants of the genus *Iridomyrmex*, which were present on the foodplant attending aphids, possibly attend the larvae of *P. spinifera.* Probably the larvae behave in a similar way to other species of *Paralucia*, feeding at night and resting in cracks in the soil at the base of the foodplant during the day and pupating in similar positions. In the laboratory the only larva that pupated spun a silken pad prior to pupation but spun no central girdle. The duration of the larval stage was about 48 days in the laboratory at about 22°C but the pupal duration is not yet known. Observations suggest that there is a single generation each year.

Specimens were collected in a partially cleared sclerophyll forest dominated by regrowth *Eucalyptus bridgesiana* R. T. Baker about 8 m high with an understorey of *Bursaria spinosa, Styphelia* sp. and *Cassinia* sp. *P. spinifera* could be found on few *Bursaria* bushes and the population appeared to be very small in the half hectare of forest remaining. Further damage to the vegetation or over collecting at the type locality must place this colony, the only one so far known, in jeopardy.

Acknowledgements

We thank Dr R. W. Taylor for identifying the ant, Mr M. I. H. Brooker for identifying the *Eucalyptus*, Mr S. P. Kim for the drawings and Mr J. P. Green for photographing the adults.

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THE BIOLOGY OF THE TREE LUCERNE MOTH *URESIPHITA ORNITHOPTERALIS* (GUENÉE) (LEPIDOPTERA: PYRALIDAE) IN SOUTHERN TASMANIA

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Introduction

Uresiphita ornithopteralis (Guenée), commonly called the Tree Lucerne Moth (McCallan, 1973), is indigenous to Tasmania occurring on several food plants. Although of only minor pest status, the moth may cause severe damage by the defoliation of garden shrubs and plants. Species of *Cytisus*, particularly *C. proliferus* L. (Tree Lucerne), and the many varieties of *Genista* (Brooms) grown in gardens as ornamental shrubs, are subject to attack. *U. ornithopteralis* was first described by Guenée (1857) who placed it in the genus *Mecyna.*

Specimens of the adult moth have been lodged with the Australian National Insect Collection.

Occurrence

Guenée (1857) recorded the moth from Tasmania while Hampson (1899) regarded the species as the only member of the genus in Australia. Butler (1877)

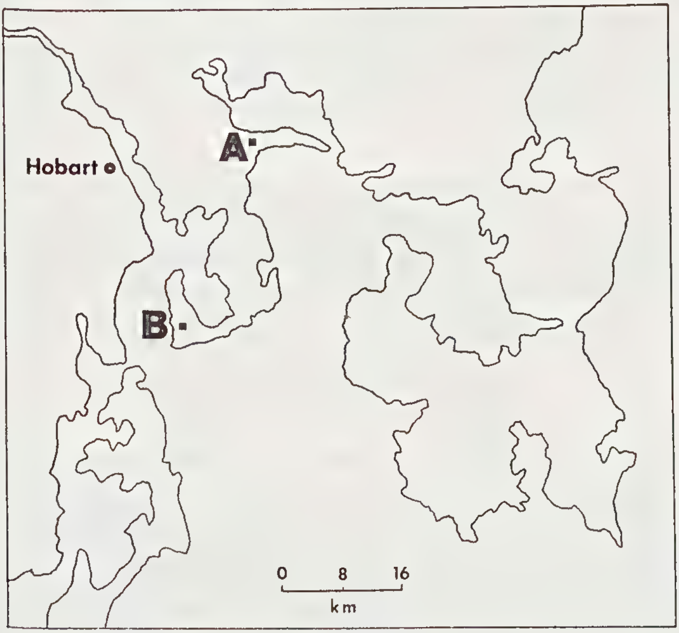


Fig. 1. Study areas in southern Tasmania.

noted the moth in a collection from New Zealand and Turner (1918) presents records from Lord Howe Island and Norfolk Island. Turner (1925) included *U. ornithopteralis* from Launceston and Hobart in a revision of Tasmanian Lepidoptera.

Specimens have been recorded from Blackmans Bay, Dodges Ferry, Lindisfarne, Mt Stuart, Taroona and Verona Sands on *C. proliferus* and various garden shrubs, and from Sandy Bay on *Betula pendula* Roth. (Silver Birch) (Martyn *et al.* 1969, 1970, 1975, 1976). Other specimens have been collected from ornamental lupins at Lauderdale, and from *C. proliferus* at Sandy Bay (Bashford, unpublished).

Specimens in this study have been collected in southern Tasmania from two areas each with a different host plant (Fig. 1); from Llanherne (Area A), on *Genista monspessulana* (L.) Johnson (Canary Broom) and from South Arm (Area B) on *Genista maderensis* (Webb and Berth.) Lowe (Mediterranean Broom).

Culture methods

Observations on the larval and pupal stages were made from field collected eggs and larvae maintained in the laboratory. Egg batches on leaves placed on damp filter paper in glass petri plates hatched without mortality. The individual groups of larvae from each egg batch were placed in glass dishes, 15 x 15 x 3 cm, containing fresh *Genista* foliage, and held in a cage outdoors. Fresh food was supplied as required and the dishes were cleaned weekly to prevent fungal attack. Specimens required for head capsule measurements were removed from the cultures regularly, killed in 50% alcohol, then measured under x25 magnification using a graticula. All adults emerging from cultures or caught in light traps were sexed.

Description

Egg:– The flat oval egg is laid within a batch of 10-15 on the upper leaf surface. When first laid the egg is white in colour and turns pale yellow after 24 hours. The transparent irregularly shaped chorion is soft and flexible (Fig. 3).

TABLE 1. Egg measurements (mm). Means of 20 eggs.

	egg	chorion
Width	0.64	0.80
Length	1.12	1.44
Thickness	0.32	0.32

Larva:– First instar pale green with black markings, head capsule brown. Final instar (fourth) pale green with a few hairs and black lateral areas containing white spots around the spiracles of each segment. Head capsule brown after ecdysis, darkening to black late in each instar. Three thoracic segments each with a pair of segmented legs. Abdominal segments carry four pairs of prolegs, anal prolegs on terminal segment (Fig. 4).

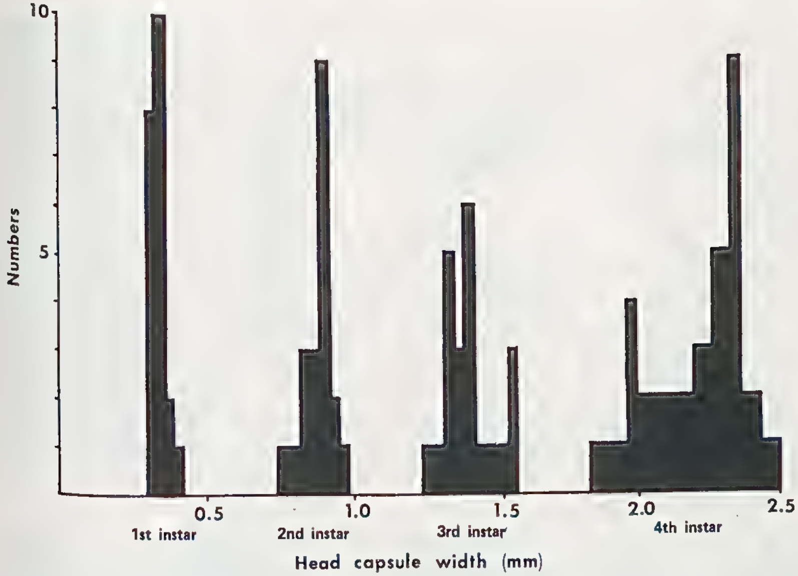


Fig. 2. Histogram of head capsule widths of *Uresiphita* larvae.

TABLE 2. Body length measurements (mm).

instar	mean	range	n
1	3.3	2.2 - 5.8	21
2	9.4	8.7 - 9.6	16
3	11.6	9.1 - 14.1	20
4	23.0	17.4 - 29.9	33

Pupa:– The pupa is slender, delicate, light brown in colour becoming very dark as the pharate adult darkens a few days before emerging (Fig. 5).

TABLE 3. Pupal measurements (means of 10 pupae).

Length	13.8 - 15.8 mm
Width	3.7 - 4.0 mm
Weight	0.06 - 0.12 g
Mean weight of males	0.11 g
Mean weight of females	0.09 g

Adult:– The moth conforms to the generic description of *Uresiphita* (*Mecyna*) by Hampson (1899).

Sexes are similar in both coloration and wing pattern. Forewing dark brown to black with broad patterned grey transverse band from costa to tornus. Hind wing orange with margins brown to black, dorsum fringe orange. Dorsal region of head black, ventral region white. Labial palps beak-like, black. Thorax black dorsally and white underneath. Abdomen dark yellow with black dorsal stripe and white ventral surface (Figs 6, 7).

Adult wing venation and structure of frenulum are as illustrated by Common (1970).

Sexual differences: – (1) Frenulum: male with a single robust bristle; female with two bristles, one stout, one slender. (2) Scales on anal segment: male long and tufted; female short, fringing the external genitalia. (3) Males often lighter in colour with slightly smaller wing span.

Biology

Eggs are laid in groups overlapping in a regular 'tile' formation as the female moves down the midrib of the leaf. Eggs are first laid near the tip of the leaf, the female moving towards the central axis of the shoot. Most egg batches are laid on the upper leaf surface. Hatching occurs after 10-14 days and the gregarious first instar larvae feed on the leaf surface at the egg site, creating characteristic patches. The second instar larvae individually migrate. They move to the tips of leaflets where they spin a fine protective web around the shoot on which they are feeding. Growth and development through four instars takes 27-56 days (Fig. 2).

If the larval density is high (3-5 larvae per shoot) severe defoliation will occur, frequently killing some branches (Fig. 8). The final instar larvae migrate after a period of feeding and pupate within a fine white silk web spun in loose litter or in sheltered positions. Migrations of up to 30 metres by final instar larvae seeking pupation sites have been observed.

TABLE 4. Duration of larval instars.

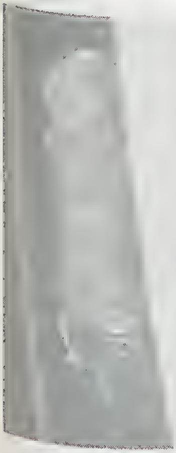
instar	days
1	4 - 10
2	10 - 12
3	7 - 9
4	6 - 25

The pupal duration varies with each generation.

TABLE 5. Duration of pupal period (days).

emergence	range	mean	
January	9 - 12	11	n = 5
April	21 - 41	35	n = 9
July	84 - 114	100	n = 4

Moths have been taken in UV light traps at the study sites each year since February 1972. These collections demonstrate clearly three distinct flight periods each year. The two major emergence periods are (a) mid-March to mid-April, and (b) mid-June to late July. The third emergence period, resulting from a small over-wintering larval population, occurs from early November to early February, the peak being mid-January. The life span of adult moths held in outdoor cages ranged from 4 - 9 days. The sex ratio of males to females was 4:1 in the cultures and 0.9:1 in the light trap collections.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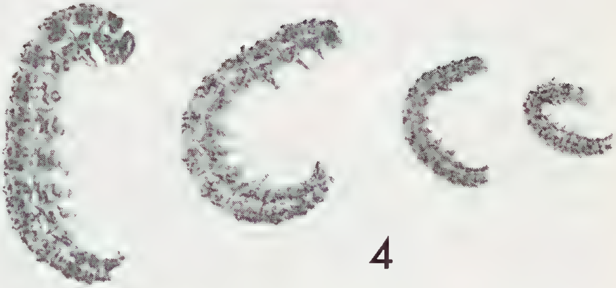
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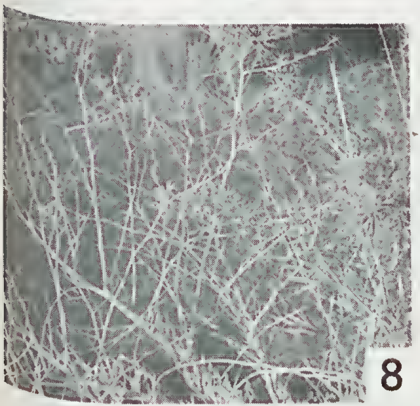
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Figs 3-8. *Uresiphita ornithopteralis*: (3) egg batch on leaf; (4) larval instars 1-4; (5) pupae; (6) dorsal and (7) ventral markings of male adult; (8) severe defoliation of *G. monspessulana.*

Despite field collections of several hundred larvae from different sites and over several seasons no parasitism has been recorded. The larvae react violently when touched or disturbed by curling and twisting the body and by regurgitating gut contents. The fine network of silk around the shoots affords a degree of protection while the larvae are feeding.

Discussion

U. ornithopteralis completes three generations each year in southern Tasmania, and appears to be free from parasitism. No bird predation has been observed but numbers of Blue Wrens (*Malarus cyaneus*) are frequently active at study sites in *Genista* bushes. Due to the clearing of land at the study sites, the area occupied by the host plants has been greatly increased. The moth population has increased particularly at Llanherne where the majority of new *Genista* plants carry several larvae per twig at different stages of development virtually throughout the year. The ability of the plant to refoliate eaten shoots in a short period enables three generations a year to be completed. Damage to *Genista* can be significant and prized garden shrubs may be severely defoliated. Hand removal of the larvae as they appear will enable the gardener to prevent noticeable damage.

Acknowledgements

I wish to thank Mr K.L. Taylor, Dr K.R. Norris, Dr P.B. Carne (C.S.I.R.O., Division of Entomology) and Dr H. J. Elliott (Forestry Commission, Tasmania) for their criticism of the manuscript.

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SOME NEW FOOD PLANTS FOR VARIOUS QUEENSLAND BUTTERFLIES

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Unless otherwise stated, eggs or larvae were found on the plants listed and were then reared to the adult stage on the same plant species. The records of the northern Queensland species shown from Mt Tamborine were obtained in breeding cages at the Tamborine Mountain Butterfly Farm.

A brief description is given of some of the plants which have distinctive features. Those plants marked by an asterisk are introduced species. All the localities mentioned are in Queensland.

Graphium macleayanum macleayanum (Leach)

Cryptocarya hypospodia F. Muell (Lauraceae). Mt Tamborine, Jan. 1975. Typical "Laurel" looking plant with green stems and a strong odour to crushed leaves. This species was collected from the Kolan River, 50 km north of Gin Gin. *G. macleayanum* laid on it soon after it was planted in the author's garden.

Endiandra pubens Meissn. (Lauraceae). Mt Tamborine, Mar. 1975. Large rain forest tree, stiff leaves covered in reddish hairs; large red fruit, 40 mm diameter.

Graphium macleayanum wilsoni Couchman

Daphnandra repandula F. Muell (Monimiaceae). Danbulla State Forest, Atherton Tableland, Aug. 1976. Rain forest tree, strongly serrated yellowish leaves, new growth with flattened stems at junction.

Graphium sarpedon choredon (C. and R. Felder)

Cryptocarya hypospodia F. Muell (Lauraceae). Kolan River, 50 km north of Gin Gin, Dec. 1973.

**Cinnamomum cinnamomum* Cockerell (Lauraceae). Mt Tamborine, Jan. 1977. From south-east Asia and commonly grown in gardens in northern Queensland.

Graphium eurypylus lycaon (C. and R. Felder)

**Annona glabra* L. (Annonaceae). Russell River, near Babinda, northern Queensland, May 1974. Small tree, glossy grey-green leaves, very soft stems and large smooth fruit 120 mm diameter. From Florida, U.S.A., but now naturalised in swamps in coastal northern Queensland.

Uvaria goeziana F. Muell (Annonaceae). Mt Tamborine, Dec. 1977. Plant originally collected from Kuranda, northern Queensland.

**Michelia champaca* L. (Magnoliaceae) (Yellow Magnolia). Mt Tamborine, Dec. 1977. From India and Malaysia. Three larvae were placed on this plant soon after hatching from the egg and they developed normally.

It is interesting to note that the author has observed *G. eurypylus* laying on *Magnolia grandiflora* but the larvae would make no attempt to feed on this plant.

Graphium agamemnon ligatum (Rothschild)

Xylopia maccreai (F. Muell) L. S. Smith (Annonaceae). Kuranda, northern Queensland, Aug. 1975. Small rain forest tree, new leaves yellowish-green and covered with fine white hairs.

* *Annona glabra* L. (Annonaceae). Russell River near Babinda, May 1974.

Melodorum urhii F. Muell (Annonaceae). Kuranda, May 1974. Climbing shrub, woody stems, new growth covered in reddish brown hairs.

* *Michelia champaca* L. (Magnoliaceae) (Yellow Magnolia). Cairns, Aug. 1977. Larvae found on plants at a nursery in Cairns. Plants are now growing well in the author's garden at Mt Tamborine.

Papilio anactus W. S. Macleay

* *Feronia limonia* Swingle (Rutaceae) (Wood Apple). Mt Tamborine, Dec. 1973. From Malaysia, purchased from a nursery in Cairns.

Papilio aegeus aegeus Donovan

Clausena brevistyla Oliver (Rutaceae). Danbulla State Forest, Atherton Tableland, Aug. 1975.

Flindersia australis R. Br. (Meliaceae). Mt Tamborine, Jan. 1972. Mostly grows in the dry Hoop Pine scrubs.

Flindersia schottiana F. Muell (Meliaceae). Mt Tamborine, Jan. 1974. Large rain forest tree, very open growth, leaves with very fine hairs.

* *Murraya koenigii* Spreng. (Rutaceae) (Curry Tree). Mt Tamborine, Jan. 1977. From south east Asia. Commonly grown in gardens in northern Queensland.

Papilio fuscus capaneus Westwood

* *Murraya koenigii* Spreng. (Rutaceae). Mt Tamborine, Jan. 1977.

Papilio ambrax egipius Miskin

Clausena brevistyla Oliver (Rutaceae). Danbulla State Forest, Atherton Tableland, Aug. 1976.

Zanthoxylum ovalifolium Wight (Rutaceae). Tolga, Atherton Tableland, Aug. 1975. Small tree, leaves mostly trifoliate, sometimes with four or five leaflets; a few thorns on limbs and also on underside of leaves; large white citrus-like flowers and small red fruit.

Zanthoxylum brachyacanthum F. Muell (=*Z. veneficum*) (Rutaceae). Danbulla State Forest, Atherton Tableland, Aug. 1976. Small rain forest tree, new growth reddish, thorns on leaves and all over trunk.

* *Murraya koenigii* Spreng. (Rutaceae). Mt Tamborine, Jan. 1977.

* *Feronia limonia* Swingle (Rutaceae) (Wood Apple). Cairns, May 1973. Larvae and eggs were found on a plant in a nursery at Cairns.

Cressida cressida cressida (Fabricius)

Aristolochia thozetii F. Muell (Aristolochiaceae). Yorkey's Knob, near Cairns, May 1974. Very small vine which grows near the beach, narrow pointed leaves.

Catopsilia pomona pomona (Fabricius)

Cassia magnifolia F. Muell (Caesalpiniaceae). Georgetown, 300 km east of

Normanton, Aug. 1975. Small shrub to 1.5 m high; large glossy compound leaves and large yellow flower spikes on top of bush; can produce new growth regardless of weather conditions.

***Eurema hecabe phoebus* (Butler)**

Acacia spectabilis A. Cunn. ex Benth. (Mimoaceae). Mt Tamborine, Mar. 1975. Medium sized wattle from inland southern Queensland; small grey/green compound leaves.

***Polyura pyrrhus sempronius* (Fabricius)**

Abarema sapindoides (A. Cunn.) Kosterm (= *Pithecellobium pruinosum*) (Mimosaceae). Mt Tamborine, May 1975.

***Doleschallia bisaltide australia* C. & R. Felder**

* *Pseuderanthemum bicolor* Radlk. (Acanthaceae). Mt Tamborine, Jan. 1977. Shrub 1 m from south east Asia, leaves with dark purple underside.

* *Graptophilum pictum* Griff. (Acanthaceae). Mt Tamborine, Jan. 1977. Shrub 1 m from Papua New Guinea and Malaysia. Extremely variable from all purple leaves to pink and green; pink flowers in terminal clusters.

* *Strobilanthus isophyllus* T. Anders. (Acanthaceae). Mt Tamborine, Jan. 1977. Shrub 1.5 m from India, purple leaves and stems.

* *Asystasia gangetica* (L.) T. Anders. (Acanthaceae). Wallaville, Jan. 1972. Small soft-leaved shrub from tropical Asia commonly grown in gardens in northern Queensland; may have white, pink, blue or yellow flowers.

***Hypolimnas bolina nerina* (Fabricius)**

* *Asystasia gangetica* (L.) T. Anders. (Acanthaceae). Wallaville, Jan. 1972.

***Hypolimnas misippus* (Linnaeus)**

* *Asystasia gangetica* (L.) T. Anders. (Acanthaceae). Wallaville, Jan. 1974.

***Hypolimnas alimena lamina* Fruhstorfer**

* *Asystasia gangetica* (L.) T. Anders. (Acanthaceae). Cairns, May 1974.

* *Graptophilum pictum* Griff. (Acanthaceae). Mt Tamborine, Jan. 1978.

***Precis orithya albicincta* (Butler)**

* *Asystasia gangetica* (L.) T. Anders. (Acanthaceae). Wallaville, Dec. 1971.

***Precis hedonia zelima* (Fabricius)**

* *Hemigraphis colorata* Hallier F. (Acanthaceae) (Metal plant). Cairns, Aug. 1976. From Java, prostrate plant with purple leaves and a metal-like shine on top; commonly grown as a ground cover in Cairns gardens.

***Euploea core corinna* (W. S. Macleay)**

Carissa ovata R. Br. (Apocynaceae) (Current Bush). Wallaville, Dec. 1975. Small climbing shrub with black fruit, milky sap and covered in thorns; grows in dry scrubs as well as rain forest.

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Thanks are extended to the Queensland Herbarium and to Tony Irvine of C.S.I.R.O. Division of Forest Research, Atherton, for identifying many of the plants.

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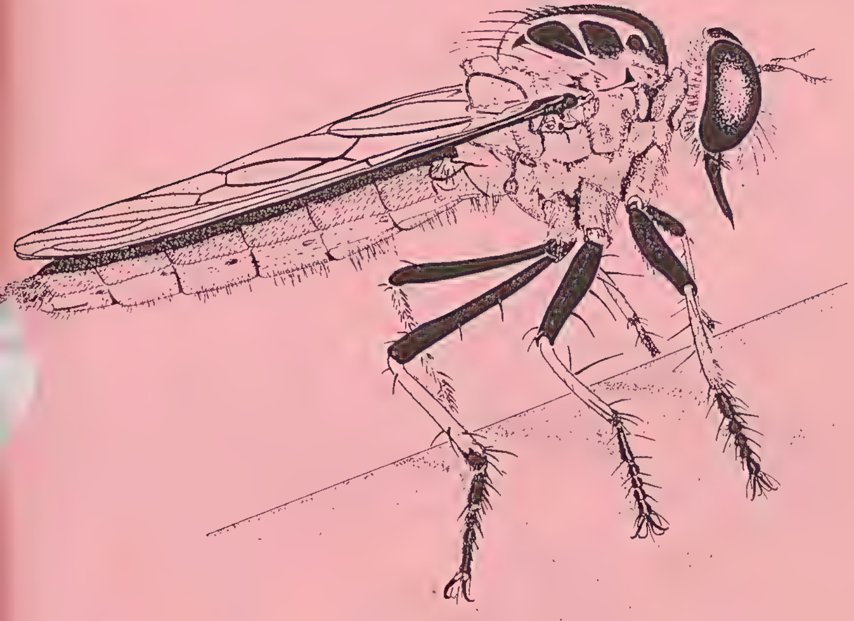

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COVER

Illustrated by Greg Daniels.

Depicts the Australian robber fly, *Ommatius angustiventris* Macquart, a common species found throughout the east coast from central Queensland to eastern Victoria. One of the few Australian Asilidae that has adapted to suburban gardens, its larvae are found in rich loamy soils. The adults prey on insects of many orders and usually catch them in flight.

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OBSERVATIONS ON TWO OVERWINTERING CLUSTERS OF *DANAUS PLEXIPPUS* (L.) (LEPIDOPTERA: NYMPHALIDAE) IN THE SYDNEY AREA DURING 1978

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Abstract

Two overwintering cluster sites of *Danaus plexippus* (L.) at Bayview and Wallacia in the Sydney area, are recorded for the first time. Observations made during 1978 at these sites are presented. Possible environmental factors influencing clustering and breeding activity during winter are discussed.

Introduction

The occurrence of overwintering clusters of *Danaus plexippus* (L.) (wanderer butterfly) was first recorded in Australia in 1965, at sites to the south-west of Sydney, in the Razorback area and near Theresa Park (Smithers, 1965). Further cluster sites were also known at Menangle Park and Otford. Prior to 1965 clustering activity of *D. plexippus* had been observed in the Hunter Valley and Adelaide areas, although no detailed studies were made (Rayment, 1942; Dowling and Haines, 1963).

During 1978, as part of a current study on the breeding status of *D. plexippus* during winter in the Sydney area, regular observations were made at two newly discovered overwintering sites at Bayview and Wallacia. These observations are presented and discussed with respect to their significance to the reproductive ecology of *D. plexippus* during winter in the Sydney area.

The overwintering site at Wallacia, 41 km from Sydney in the central west of the Sydney basin is similar in configuration to the previously recorded sites at Razorback and near Theresa Park (Smithers, 1965). It consists of a narrow, lightly wooded gully situated in moderately hilly country used mainly for stock grazing.

The site at Bayview, a northern coastal suburb 20 km from Sydney, occupies a very small area at the top of a small hill within a residential district. The site is lightly wooded waste land with abandoned vehicles and general refuse littering the area.

Observations of clustering activity at both sites commenced in mid May, and continued throughout the period of clustering. Observations were made bimonthly at both sites although weekly visits were made to the Wallacia site during the latter half of the clustering period. Data compiled during each visit included weather data, counts of the cluster population, estimations of sex ratios, and observations of behaviour. In addition samples of females were taken for dissection. Population counts involved counting individual clusters on branches and bushes when the insects were least active, i.e. early morning or late afternoon. As the clusters invariably reformed on the same branches throughout the period of clustering, some uniformity was preserved in the assessment of numbers at each visit. Sex ratios were estimated by netting small clusters of 50 to 100 individuals when possible, and treating these specimens as a representative sample. General observations were made at each visit of flight activity, courtship behaviour, and evidence of mortality. The small samples of females taken at each visit were dissected to gain an indication of the reproductive condition of the cluster. Results from these dissections are considered fairly representative of the cluster as a whole. Any ovarian development would probably occur more or less simultaneously throughout the cluster population, given that environmental influences would be basically uniform within the restricted area of a clustering site. Larger samples were not considered because of possible adverse effects upon the future reproductive potential of the cluster populations.

Results

In 1978 clustering activity of *D. plexippus* commenced at both sites in mid May. On the 28th May 500 specimens were counted at Bayview and 1000 specimens at Wallacia, in the main clusters at each site. By mid June the Bayview population had increased to 800 specimens, while the Wallacia population remained at 1000 specimens. By the end of June populations at both sites had declined, to 400 specimens at Bayview, and 800 specimens at Wallacia. Populations diminished further during the first week of July, and the clusters dispersed completely at both sites between the 9th and 18th of July.

Throughout the period of clustering the Wallacia population maintained an approximately equal ratio of males to females. However, from an initially equal sex ratio, the Bayview population became predominantly male from mid June onwards. There was no immediately apparent explanation for this sudden sex ratio imbalance. There was no evidence of heavy female mortality at this time, indeed cluster mortality appeared to be minimal. As cluster numbers at Bayview increased by nearly 50% at this time it is possible that the new influx was predominantly male creating the resulting imbalance. Alternatively a substantial proportion of the females present at the end of May, may have left the cluster during early June.

The total cluster populations at Wallacia and Bayview in 1978 although impressive, were not as vast as the cluster populations seen in the Razorback area during the early sixties (Smithers, 1965). The Razorback clustering site mentioned by Smithers (Smithers, 1965; 1972) was also kept under observation during the winter of 1978. The largest total population seen at that site was

500 specimens in mid June. The date of cluster formation was not recorded, but dispersal occurred significantly later than at the Bayview and Wallacia sites. Small numbers were still present at the Razorback site on 12th August.

Behaviour of the cluster populations at Bayview and Wallacia varied according to prevailing weather conditions. On sunny days a period of flight activity usually occurred from 11 am to 3 pm E.S.T. By mid afternoon clusters would begin reforming. During periods of dull overcast weather the clusters would remain inactive. The availability of suitable flowers for nourishment was very limited at both sites, but particularly at Wallacia. It seems likely that cluster individuals contain enough body fat reserves at commencement of clustering to sustain them through the two months or so of reproductive diapause. It is possible that some benefit is gained from "drinking" beads of moisture or from damp ground, although this was not observed. Mating was observed at both sites throughout the period of clustering. It was common to observe courtship flights during periods of flight activity.

Mortality of the cluster populations at both sites, as evidenced by wings on the ground, increased progressively through the clustering period. Birds were never observed to prey on the clusters or on individuals in flight during the visits. However, beak marks on some of the wings found suggests that at least some attacks were made. Adverse weather conditions with above average rainfall and frequent strong winds during late June probably accounted for much of the observed increased mortality at this time.

Dissections of samples of females taken from both sites soon after clustering commenced revealed no evidence of ovarian development. Ovaries were small and showed no trace of yolk deposition. They were comparable in size and weight (1-2 mg) to the inactive ovaries of newly emerged adults. Oogenesis was not detected in any of the samples taken during June. Some sampled females did show evidence of oosorption as indicated by immature oocytes in various stages of fragmentation, and by the presence of pigmented breakdown products at the base of the ovarioles. These were possibly females that had previously undergone at least some ovarian development before environmental conditions initiated a reproductive diapause. Actively breeding adults under summer conditions never show oosorption characteristics. Two females taken from the Wallacia cluster on 8th July contained ovaries showing extensive yolk deposition along the ovarioles. Two females taken from the Bayview site on 9th July also exhibited extensive yolk deposition, together with the formation of some immature oocytes. On the 15th July two females taken from the Wallacia site showed extensive yolk deposition and large numbers of immature oocytes. By the 18th July the Wallacia cluster had dispersed and the Bayview cluster was not in evidence on 22nd July, although it probably dispersed a few days earlier. From this limited sampling of females from both cluster sites it suggests that significant ovarian development preceded cluster dispersal, although dispersing females were probably not gravid. However, mature oocytes and reproductive activity would probably be attained soon after dispersal. Similar sampling of females at the Razorback cluster site was also undertaken.

Two females taken on 12th August were gravid with 7 and 14 mature oocytes respectively. This was prior to the complete dispersal of the cluster. The apparently gravid condition of dispersing females from the Razorback cluster as opposed to the non gravid condition of dispersing females from the Bayview and Wallacia sites, may possibly be explained by differences in geographical location and duration of clustering period.

Discussion

The mechanisms and significance of overwinter clustering of *D. plexippus* in Australia are not as well understood as those of the same species in the United States. In that country vast migrations ranging over thousands of miles precede clustering activity. Two main overwintering areas are known, one in Mexico and the other in California. From extensive tagging programmes it appears that the western *D. plexippus* population of North America overwinters in California, and the Eastern population in Mexico (Urquhart, 1976; 1977). Although population movements do occur in Australia, they appear to be mainly related to an annual extension and contraction of range (Smithers, 1977). Only one obvious unidirectional flight has been reported (Smithers, 1965). From earlier studies on the breeding ecology of *D. plexippus* in the Razorback area (Smithers, 1972), it appeared that cluster populations were not derived from individuals in the cluster area. Furthermore cluster individuals did not appear to breed in the cluster area after dispersal. It would therefore seem that some degree of migration is associated with clustering activity in the Sydney area.

At both the Bayview and Wallacia sites, breeding populations of *D. plexippus* existed alongside the reproductively inactive cluster populations during the winter of 1978. Eggs and larvae were found through the winter on healthy plants of *Gomphocarpus fruticosus* (milkweed), the major food plant of *D. plexippus* in the Sydney area. In addition, gravid females were captured at both locations flying over the breeding areas. Reproductive activity in *D. plexippus* is under environmental control, primarily temperature and photoperiod. Lowering of temperature and shortening of photoperiod initiate reproductive diapause and associated migratory and clustering behaviour (Barker and Herman, 1976). The situation of breeding and non breeding populations could only arise if post eclosion environmental influences on each population differed. If cluster populations are derived from other areas, then it is possible that a different set of environmental influences could operate during the critical post eclosion period, than those found in the breeding areas, adjacent to the cluster site. A further possibility is the existence of differing micro and meso climates at different breeding areas, influencing the extent of reproductive activity in populations of newly emerged specimens. The timing of the emergence of new generations, with respect to prevailing weather conditions encountered, could also be of significance. The fact that breeding and cluster populations can exist in the same area without the cluster population becoming reproductively active, suggests some difference in environmental conditions between the cluster and breeding sites. Alternatively there may be some difference in response to environmental conditions by newly emerged and diapause females. The overwintering sites known in the Sydney area are invariably shady locations, and all but the Bayview site are situated in gullies or narrow valleys. A gully situation offers very limited insolation during the winter months, with direct sunlight penetrating for only a short period daily. The winter breeding areas at Bayview and Wallacia in 1978 were situations receiving maximum influence from the sun. The breeding site at Wallacia was situated on a hillside facing north and received sunshine from sunrise to sunset during the winter. The cluster area barely two hundred metres distant in the shadow of the breeding site hillside, received sunshine for a much shorter daily period. Some preliminary work on the influence of insolation upon ovarian development in *D. plexippus*, has indicated that this factor may be of great significance to breeding activity during winter in the Sydney area. Batches of newly emerged females kept in sunny and shady situations in a single location, under winter conditions, demonstrate significant differences in ovarian development. The specimens receiving daily sunshine produced mature oocytes after one week, whilst the specimens receiving no sunlight showed no ovarian development after the same period. Although newly emerged females during winter are unlikely to remain in sunlight for the maximum period available, they will experience significantly more than individuals at a cluster site. The environmental control of the reproductive ecology of *D. plexippus* in the Sydney area during winter is currently being investigated. It is hoped this will provide a greater understanding of winter breeding and clustering activity, and of the factors involved.

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BOOK REVIEW

Butterflies of South Australia by Robert H. Fisher. 1978. Issued by the Handbooks Committee on behalf of the South Australian Government. 272 pages, 16 coloured plates, many b. & w. photographs. Price $9.50.

In recent years several new books on Australian butterflies have appeared. All concern our butterflies on a national basis and aim primarily at illustrating the adult insects and summarizing known distributions and life histories. The present title is a little different. It is the first modern book covering Australian butterflies at a state level and it leans towards an emphasis on life histories. Most of the 64 species known from South Australia have at least some portion of their life history illustrated, many for the first time. In fact a number of the life histories described are entirely new.

It is a comprehensive and authorative text which begins with several introductory chapters concerning historical aspects, classification, life histories, structure, origins and distributions of South Australian butterflies, making and storing a collection and the study and recording of life histories. These chapters comprise approximately one quarter of the text and while the discussion of each topic is condensed, much valuable and interesting information is included.

The remainder of the book, a systematic treatment of the South Australian fauna, covers each species in turn, listing its synonomy, describing the adult insect, listing the known food plants both for South Australia and elsewhere, describing in detail the species life history and summarizing its distribution within South Australia and beyond. This section contains a wealth of information and it is here that the numerous life history photographs compliment the text so effectively. These photographs are in general very clear and portray eggs, larvae in various instars, larval shelters of Hesperiidae, pupae and some habitat and food plant shots. The majority of the photographs are black and white but there are also included two colour plates, each containing 8 figures.

Fourteen coloured plates of adult butterflies illustrate all the species known from the State, and when used in conjunction with the keys included in the text, should leave little doubt that a correct determination has been reached.

I have some minor criticisms. The colour plates, especially the two of life histories should have been much larger. The comparatively small additional cost involved in enlarging the life history figures would have done justice to the colour photographs; instead much detail is lost. It would also have helped had the black and white figure numbers been given for each species under its heading; the colour figures are so listed.

As a whole the book must be considered an outstanding work and one that is remarkably free of typographical errors. It should be on the shelf of everyone interested in Australian butterflies as the scope of this book reaches far beyond the boundaries of South Australia. It is very good value for money and the price is within the reach of most.

M. S. Moulds

SOME NEW FOOD PLANTS FOR AUSTRALIAN LEPIDOPTERA WITH LIFE HISTORY NOTES

By Murdoch De Baar
25 Irwin Terrace, Oxley, Queensland, 4075.

This paper records food plants and life history notes on butterflies and a hawk moth, in addition to those given by Common (1963), McCubbin (1971) and Common and Waterhouse (1972). The butterfly nomenclature follows that of Common and Waterhouse (1972).

HESPERIIDAE

Chaetocneme sp.

Croton insularis (Family Euphorbiaceae). Three empty pupal cases were found on this plant during Jan. 1976, at Brisbane, Queensland. In the absence of adults the species could not be identified.

Trapezites iacchus (F.)

Lomandra multiflora (Family Xanthorrhoeaceae). A series of larvae were collected on this *Lomandra* near Petrie, Queensland, and the adults emerged between 19 Feb. and 3 Apr. 1977 and also during Mar. 1978. Pupal durations for seven individuals ranged from 13 to 15 days. This butterfly was also reared from the same locality during Mar. 1978 on *Lomandra longifolia* which has been previously recorded as a host by Atkins (1975).

First instar larvae are green with a black head. Mature larvae are pale brown with faint longitudinal lines and a blackish head faintly blotched with pale brown, the head has a depression on the dorsal surface.

The pupa is brown with darker blotches, with the anterior end rounded, and the head with two slight bumps on its dorsal surface. The pupa of *T. iacchus* is less densely setose than that of *Trapezites eliena.*

Taractrocera ina Waterhouse

Brachiaria decumbens, Paspalum conjugatum, Paspalum dilatatum, Paspalum urvillei (Family Poaceae). One adult was reared on 16 Apr. 1976, at Brisbane on the introduced host, *B. decumbens.* Further larvae were collected during Mar. 1978 feeding on *P. conjugatum* at Maryborough, Queensland, and *P. urvillei* at Brisbane. Those feeding on *P. conjugatum* also accepted *P. dilatatum.* Adults emerged during Apr. 1978.

Ocybadistes walkeri sothis Waterhouse

Dianella sp. (Family Liliaceae). A larva was collected at Stanthorpe, Queensland, and after feeding for 5 days on this host, pupated on 15 Jan. 1977 and emerged on 23 Jan. 1977. As *Ocybadistes* and related genera are usually grass feeders, *Dianella* is an unusual food plant, which has also been recorded as a host for *Toxidia peron* (Atkins, 1975).

Suniana sunias nola (Waterhouse)

Panicum maximum, Leersia hexandra (Family Poaceae). A large series of larvae was reared on the introduced *Panicum maximum*, collected during Mar. 1976 at Brisbane. Larvae of this species were also collected on 14 Mar. 1978 near Caboolture, Queensland, feeding on *Leersia hexandra.*

Arrhenes marnas affinis (Waterhouse and Lyell)

Leersia hexandra (Family Poaceae). A series of larvae was collected on this host growing in a swampy situation near Caboolture, Queensland, on 14 Mar. 1978.

Pupal duration for three larvae ranged from 8 to 9 days. Mature larvae are pale green with a pale brown head and an inverted v on the front of the head.

Telicota ancilla ancilla (Herrich-Schaffer)

Paspalum urvillei (Family Poaceae). A series of larvae was reared on this host during Feb. 1977 at Brisbane.

Parnara amalia (Semper)

Leersia hexandra (Family Poaceae). Larvae of this species were collected with *Arrhenes marnas affinis* near Caboolture, Queensland, 14 Mar. 1978.

PIERIDAE

Eurema hecabe phoebus (Butler)

Acacia rubida, *Acacia maidenii* (Family Mimosaceae). A large number of this butterfly was reared during Apr. 1977 at Brisbane, from larvae collected on these hosts cultivated in a garden. Juvenile bushes appeared to be the most susceptible to larval attack. *E. hecabe* has also been reared on several occasions from *Acacia maidenii* grown in Brisbane gardens (G. B. Monteith, pers. comm.). The *Eurema* larvae confine their feeding to the juvenile pinnate true leaves which are rather persistant in *A. maidenii,* a phyllodinous species.

Delias nysa nysa (F.)

Korthalsella opuntia a mistletoe (Family Loranthaceae) growing on *Geijera parviflora*. A larva and two pupae were taken on this host at Gunnedah, New South Wales. One adult emerged 3 May 1977. This food plant was recorded previously by Edwards (1963). I record my observation here confirming the record of Edwards.

NYMPHALIDAE

Euploea core corinna (W. S. Macleay)

Plumeria acutifolia "frangipani" (Family Apocynaceae). An immature larva was collected on 12 Mar. 1978 near Petrie, Queensland, feeding on the above plant. It fed for nine days, consuming a third of a leaf before dying.

Sankowsky (1975) also records a food plant belonging to the Apocynaceae for this butterfly.

Polyura pyrrhus sempronius (F.)

Caesalpinea ferrea (Family Caesalpiniaceae), *Acacia spectabilis* (Family Mimosaceae). Larvae were noted feeding on these plants during Mar. 1978 at Brisbane.

LYCAENIDAE

Hypochrysops pythias euclides Miskin

Triumfetta rhomboidea (Family Tiliaceae). Alternative host, *Commersonia bartramia* (Family Sterculiaceae). Eleven larvae were collected on 7 Dec. 1977 at Paluma, northern Queensland. When the supply of *T. rhomboidea* leaves was exhausted by 16 Dec. 1977 various alternatives were tried, one of which was accepted. Five larvae died but the remainder fed for eleven days on *C. bartramia* before the original food plant was again offered. However, one larva then refused to accept *T. rhomboidea* and was reared on *C. bartramia* during the remaining three weeks of its larval life.

Larvae rested between the main veins on the undersurface of the leaves, and did not appear to be attended by ants. Two larvae which pupated on 28 Dec. 1977 emerged on 8 and 9 Jan. 1978, and two which pupated on 5 Jan. 1978 emerged on 15 Jan. 1978. They are flattened, pale green in colour with white flecks, a thin creamish dorsal line, and dense marginal hairs. Larval shape is very similar to that of *H. byzos byzos.*

Pupae are pale brown with darker spots. Pupation occurs in the foliage, in a shelter formed by webbing a fold in one leaf, or webbing two leaves together.

Neolucia sulpitius sulpitius (Miskin)

Salicornia quinquiflora (Family Chenopodiaceae). Larvae fed on this host which was collected from tidal flats in the Brisbane area during October and November 1977. The pupal duration was 7 or 8 days.

SPHINGIDAE

Cephonodes kingi (Macleay)

Canthium coprosmoides (Family Rubiaceae). Two larvae were collected on this host at Brisbane and adults emerged about mid January 1976.

Acknowledgements

I wish to thank Mr G. B. Monteith of the Entomology Department, University of Queensland, for his helpful comments and Miss B. Lebler, Mr H. Kleinschmidt, Mr N. Byrnes and other staff of the Queensland Herbarium, for identifying plant hosts. I also wish to thank my wife Glenda for typing the manuscript.

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A TERRESTRIAL CADDIS-FLY LARVA FROM TASMANIA (CALOCIDAE: TRICHOPTERA)

By A. Neboiss

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Abstract

The larva and pupa of *Caloca saneva* (Mosely), family Calocidae, are described and figured. Larvae of this species are terrestrial and were collected in pit-traps.

Introduction

The Calocidae is a small family of caddis-flies restricted to the Australian-New Zealand region. At present three Australian genera in this family are recognised (Neboiss, 1977), but so far their immature stages have not been described. From available observations it is known that the larvae of *Tamasia* Mosely and *Caenota* Mosely live in small, fast flowing streams, but until now no data were available for any species in the genus *Caloca* Mosely.

Pit-trap collections made in eastern Tasmania by Mr J. A. Friend of Zoology Department, University of Tasmania, Hobart, were found to contain considerable numbers of caddis-fly larvae and adults. These traps, set for amphipods, were usually placed in wet sclerophyll forest some distance (20-50 m) from the nearest water. The caddis-fly larvae and adults were present irrespective of whether the traps were located in the centre of a cleared area of approximately 2 m diameter, or were completely covered with the surrounding leaf litter. This is the first record from Australia of entirely terrestrial caddis-fly larvae. It is interesting to note that the adults, of which both sexes are fully winged, were also captured in traps and apparently live under the moss and forest debris. The adults were identified as *Caloca saneva* (Mosely). A mature female pupa of this species was also collected at the same locality. Larvae from several localities in the lower Gordon River area, south-west Tasmania, appear to be the same species.

Caloca saneva (Mosely)

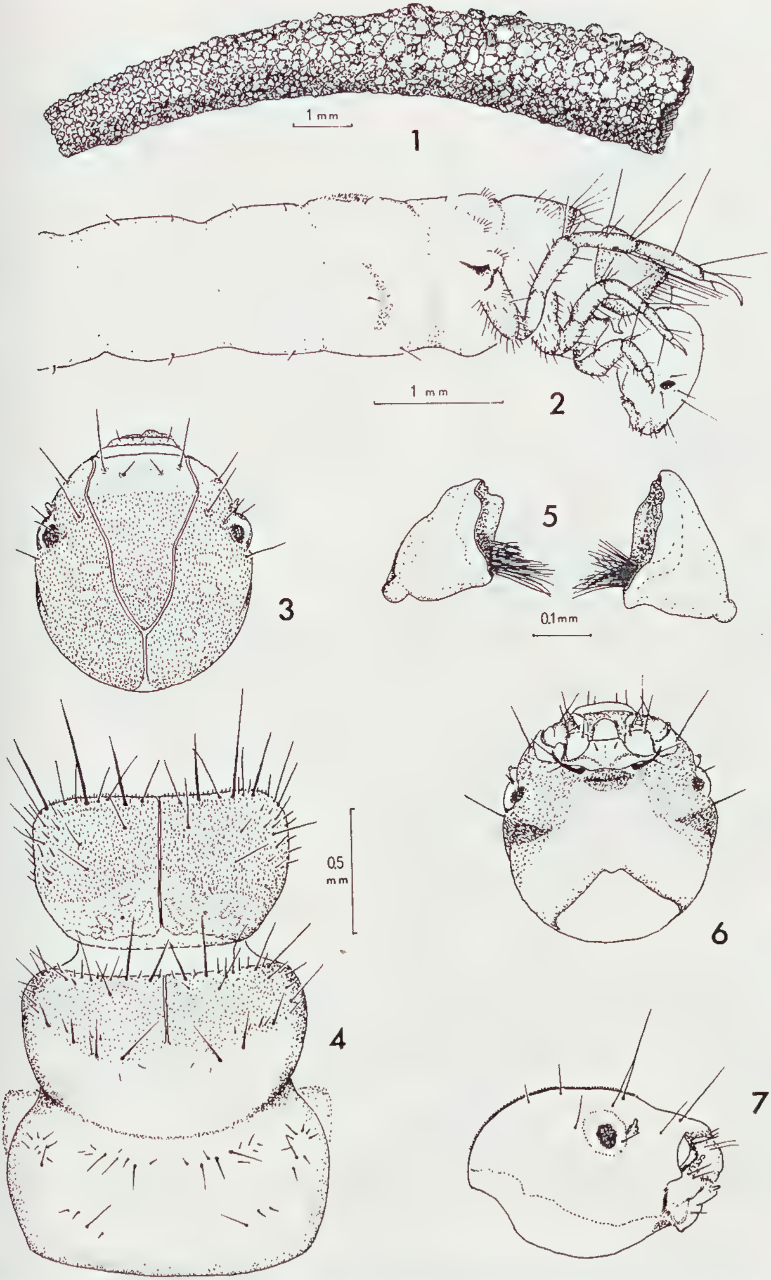
(Figs 1-13)

Tismana saneva Mosely *in* Mosely and Kimmins, 1953: 65.
Caloca saneva, Neboiss, 1977: 91.

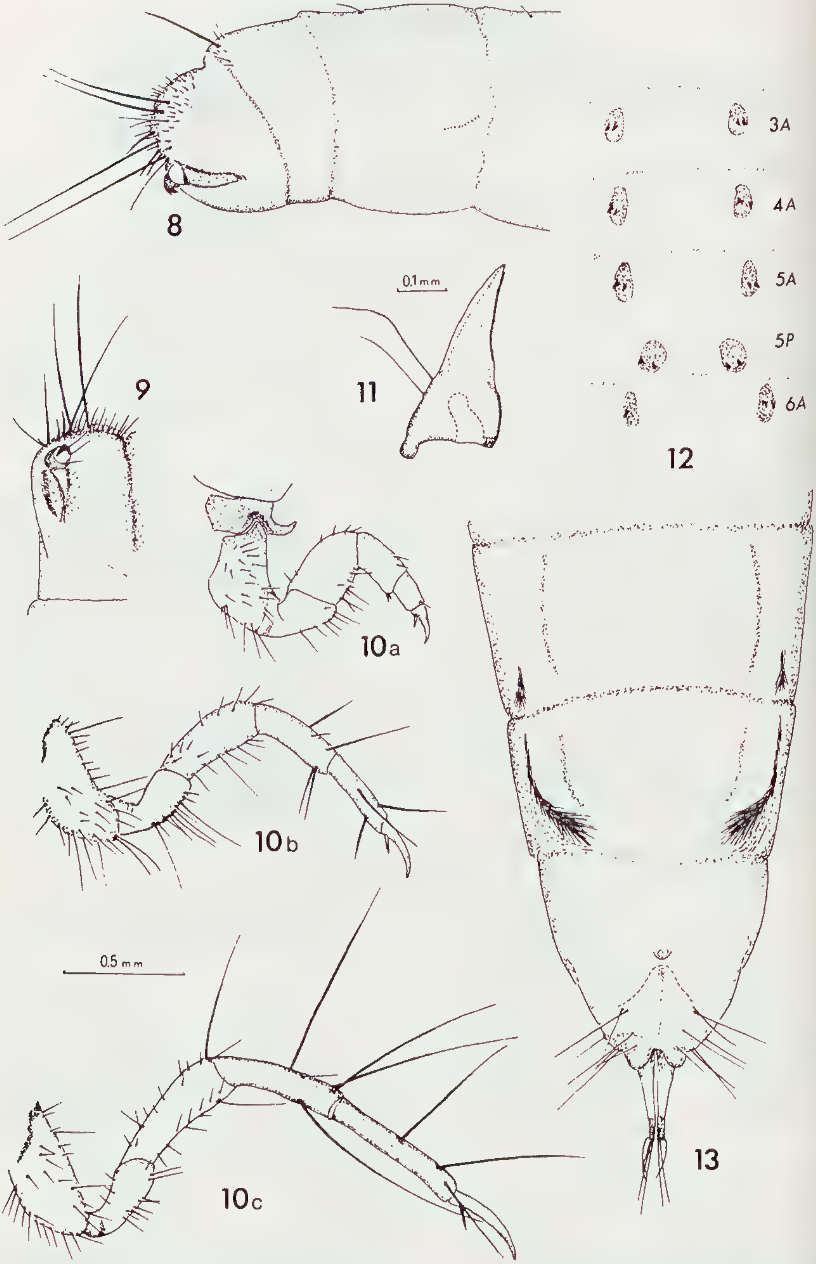
DESCRIPTION

Larva:– Maximum length 9.5 mm. Head (Figs 3, 6-7) round in frontal view, slightly flattened dorso-ventrally, covered with short spicules. Mandibles (Fig. 5) each with thick mesal brush of hair near base of inner margin, basal hairs longest; a pair of bristles on dorso-lateral margin towards base, one being long, dark, other short and pale; one to two low teeth sub-apically on each cutting edge. Antennae very short, close to, and just anteriorly of eyes.

Pronotum (Fig. 4) dark brown, with distinct mesal suture; anterior half densely covered with short spicules, posterior half with some muscle marks; anterior margin with 8-10 long, black setae, each with one or two shorter, yellowish setae interspersed. Mesonotum with only anterior half sclerotized, dark brown, median suture present, anterior margin with 8-12 dark setae, some shorter and some very short, pale setae interspersed. Metanotum not sclerotized, same



Figs 1-7. *Caloca saneva* (Mosely) larva: (1) case; (2) lateral view; (3) head dorsal; (4) thoracic segments dorsal; (5) mandibles ventral; (6) head ventral; (7) head lateral.



Figs 8-13. *Caloca saneva* (Mosely): (8) larva, last three abdominal segments lateral; (9) larva, left anal claw ventral; (10 a-c) larva, anterior, middle and posterior legs; (11) pupa, mandible ventral; (12) pupa, hookplates; (13) pupa, last three abdominal segments ventral.

colour as abdominal segments, a transverse band of small, sparse setae anteriorly. Thoracic sternites not sclerotized, pale. Anterior legs (Fig. 10) short and robust, middle and posterior legs subequal, posterior legs slightly more slender, with a few very long, conspicuous dark setae.

Abdominal segments (Fig. 2) without gills; dorsal and lateral spacing humps on segment 1 low, each with elongate sclerite and covered with short, pale yellowish spicules; venter with a pair of small, dark setae. Segments 2-6 with very small black setae, each segment with 2 dorsal and 1 ventral pair. Lateral comb of fine spicules on segment 8, curving antero-dorsally. Tergite 9 with two pairs of long, black setae on posterior margin, a few small, pale setae interspersed. Anal claw (Fig. 9) with small accessory hook; sclerotized area above anal claw with four long and some shorter, black setae and numerous pale setae.

Pupa: – Length 8.5 mm. Head with two pairs of bristles between and one in front of the eyes; one pair between the base of antennae. Labrum subquadrate, anterior angles rounded, with two pairs of setae; frontal margin slightly concave mesally; three pairs of setae near the baso-lateral angle. Mandibles (Fig. 11) symmetrical, elongate triangular, inner edge slightly convex, distal half minutely serrate, two basal bristles on outer margin.

Abdomen (Fig. 13) without gills; lateral line fringe extending from posterior quarter of segment 7 to posterior margin of segment 8. Hookplates (Fig. 12) anteriorly on segments 3-6, posteriorly on segment 5 only, usually with 2-3 hooks each. Anal processes broader at base, tapering distally, truncate apically with 3-4 terminal bristles.

Case: – Maximum length of larval case (Fig. 1) 11 mm, maximum width anteriorly 1.8 mm, tapered and curved; constructed of small sand grains which gradually increase in size anteriorly on dorsal side.

Pupal case 11 mm in length, small anterior extension added to larval case slightly narrower and somewhat looser in construction; dorsal margin formed into a short, loose lip; both ends closed with silken membranes; anterior membrane with narrow linear opening horizontally below centre, posterior one with similar linear opening horizontally at about centre.

Material examined: – TASMANIA: 6 ♂, 4 ♀, 1 ♀ pupa, 23 larvae, Tower Road nr Tooms Lake (pit-traps), 8-23 Sept. 1976, J. A. Friend; 200 ♂♀ (approx.), Tower Road, 20 m from Angler's Creek, wet sclerophyll forest (*Eucalyptus obliqua, Acacia mearnsii* and *Olearia argophylla*) with ferns (MV light) 17-19°C, 13 Oct. 1977, D. Coleman and J. A. Friend; 1 larva, 3 km SE of Tooms Lake, ex leaf litter from damp rainforest, 1 Mar. 1972, J. L. Hickman; 12 larvae, Fernglade nr Ferntree, 1975-1977, J. A. Friend. Specimens deposited in National Museum of Victoria, Melbourne.

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NEW EDITION OF THE "COMMON NAMES LIST"

A small sub-committee, comprising representatives of State Departments of Agriculture and the CSIRO Division of Entomology, has been appointed to prepare a new edition of CSIRO Bulletin No. 287 (1973) "Scientific and Common Names of Insects and Allied Forms Occurring in Australia".

Proposals for amendments of, or additions to, the list have been sought from appropriate Commonwealth and State Departments and museums. The Sub-Committee would welcome proposals from entomologists who are not associated with such organisations.

Proposals for additions to the list should include for each species: order, family, genus and species, author's name (in full), established (or proposed) common name, and a brief statement justifying its insertion in the list. The major qualifications for insertion are economic significance, abundance, or striking appearance.

Proposals should be sent, not later than 31 May, to Dr P. B. Carne, Convener, Common Names Sub-Committee, CSIRO Division of Entomology, P.O. Box 1700, Canberra City, A.C.T. 2601. Copies of Bulletin No. 287 are available on request from Dr Carne.

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All notices are printed free of charge. Persons submitting notices need not be a subscriber to the journal. Items for insertion should be sent to the editor who reserves the right to alter or reject notices.

WANTED. Butterflies from the Darwin area. Will exchange for other Australian butterflies. Dr Steve Brown, 31 Pandanus St, Fisher, A.C.T. 2611.

AMATEUR lepidopterist aged 38 would like to contact others in Adelaide for exchange of butterflies etc., and field trips. Please write 11 Devonshire Rd, Hawthorndene, S.A. 5051 or telephone 278 5692.

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WANTED. Unusual Phasmidae from Australia, New Guinea and neighbouring islands. Also other unusual Orthoptera. Will purchase or exchange. Dr M.W. Osborne, 14 Sherwood Close, Somerville, New Jersey 08876, U.S.A.

EXCHANGE. I would like to exchange butterfly specimens from Australia (especially Lycaenidae), for butterfly specimens from Canada. W. W. Gregory, 1373 Hixon St, Oakville, Ontario L6L 1R9, Canada.

WANTED. A copy of *Australian Butterflies* by Charles McCubbin. F. Sattler, 27 New Farm Rd, West Pennant Hills, N.S.W. 2120. Ph. 84 2910.

EUROPEAN entomologist wishes to exchange information and specimens. May also buy. Offer for exchange cocoons of *Attacus crameri* and *A. caesar* and pupae of *Pseudantheraea discrepans* (Congo Africa) and some *Papilio* pupae. Thorsten Weers, Oberdornen 54, 56 Wuppertal 2, West Germany.

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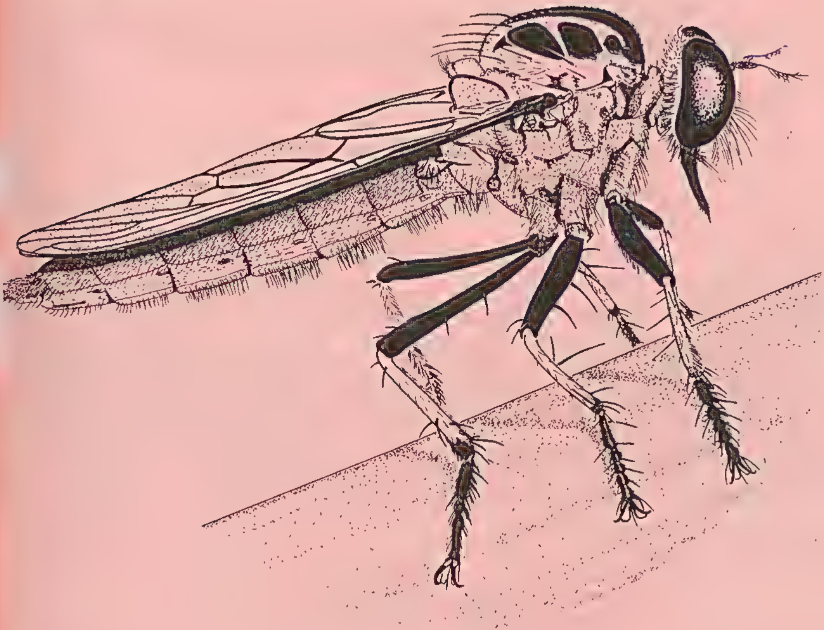

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COVER

Illustrated by Greg Daniels.

Depicts the Australian robber fly, *Ommatius angustiventris* Macquar a common species found throughout the east coast from central Queenslan to eastern Victoria. One of the few Australian Asilidae that has adapted suburban gardens, its larvae are found in rich loamy soils. The adults pre on insects of many orders and usually catch them in flight.

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GEOGRAPHICAL DISTRIBUTION OF THREE SPECIES OF SMALL ANTS COMMON IN NEW SOUTH WALES

By M. I. Nikitin
Biological and Chemical Research Institute, N.S.W. Department of Agriculture,
P.M.B. 10, Rydalmere, N.S.W. 2116

The Argentine Ant Eradication Campaign in N.S.W. created a great deal of interest by the general public in the small ants found in houses and gardens of N.S.W. A large number of ant samples was sent to the Biological and Chemical Research Institute for identification and over approximately eight years a sizeable collection was built up. The three commonest species received were *Iridomyrmex darwinianus* (Forel), *Technomyrmex albipes* (F. Smith) and *Pheidole megacephala* (F.).

Figure 1 shows the areas from which the three species have been identified. *I. darwinianus* was found along the coast between Taree and Jervis Bay and west to Dubbo, Parkes, Griffith and Finley in the south-west. In the northern part of the state *I. darwinianus* has a more restricted distribution, being identified only from the New England region.

T. albipes is more widely distributed in the north of the state and along the coast where it ranges from Ballina in the north to Bega in the south. This species reaches west to Moree, Coonabarabran, Narromine and Griffith, but does not extend as far as Finley in the south-west.

P. megacephala, in contrast, is restricted to the coastal districts from Tweed Heads to Bega. It was reported from Springwood in the Blue Mountains, west of Sydney, but not from any locality further west.

The most frequently received species was *P. megacephala*; this may be a reflection of its greater abundance or activity. However, the survey was aimed at small brown ants and the results could consequently have been biased away from small black ants, such as *T. albipes.*

Fig. 1. Map of New South Wales showing distributions of *Iridomyrmex darwinianus, Technomyrmex albipes* and *Pheidole megacephala.*

Of the three species listed in this publication, *T. albipes* and *P. megacephala* each have a wide range of distribution beyond Australia (Wilson and Taylor, 1967). *I. darwinianus* has its native range apparently restricted to Australia but was recorded, as an introduced species, from Auckland, New Zealand, by Taylor (1959). The population concerned was evidently successfully eradicated in 1959 and *I. darwinianus* has not been subsequently reported from New Zealand (R. W. Taylor, pers comm.). *P. megacephala*, considered to be a native of Africa, has been spread by commerce to almost all of the more humid parts of the tropics. It is common in Queensland, in many parts of Polynesia, including Ontong, Java, Samoa and neighbouring islands, and in the Marquesas and Hawaii.

T. albipes is considered by Wilson and Taylor (1967) to be the most widespread of all the Indo-Australian *Technomyrmex*, ranging as a dominant ant from India to eastern Australia and throughout the Pacific, including Melanesia and Micronesia. It is common in Polynesia, particularly Samoa, Tonga and neighbouring islands, as well as in Hawaii, where it was introduced possibly through human commerce.

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Aust. ent. Mag. 5(6), April, 1979

SCARABAEIDAE (COLEOPTERA) FROM THE HARRINGTON DISTRICT OF COASTAL NORTHERN NEW SOUTH WALES, WITH SPECIAL REFERENCE TO A LITTORAL RAINFOREST HABITAT

By G. A. Williams
46 Louis Street, Granville, N.S.W. 2142.

Abstract

Data are tabulated on habitat preference and periods of occurrence for 57 species of Scarabaeidae collected. Two new distribution records are noted for the rarely encountered ruteline, *Anoplognathus viridiaeneus* (Donovan). Significant range extensions are listed for species associated primarily with rainforest at Harrington, and the fragility and depauporate status of this habitat is noted.

Introduction

The township of Harrington is situated approximately 360 km by road north of Sydney, near Taree on the New South Wales coast.

Extensive dairying and pastoral areas lie to the west, separated from the town by a narrow zone of mixed *Eucalyptus* woodland-heath communities extending down from the Crowdy Bay National Park. Wetlands occur intermittently throughout the coastal plain, and small pockets of a depauporate littoral rainforest system are to be found in the lee of coastal sand dunes between Harrington and Crowdy Head 7 km to the north. Sandy soil types predominate throughout the collecting area.

The rainforest patches now remaining at Harrington after sand mining operations in the 1960's range in area from approximately 0.5 - 2.0 ha and have suffered extensively from salt burn caused by canopy disruption and sporadic inundation from dunal movement. Further habitat destruction resulting from pedestrian access and vandalism is localized but, with rainforest areas of such small size, it is significant. Areas of open woodland to the immediate west of the township suffered from bushfires in October 1976 and more extensively in February 1977.

Collecting was undertaken from late 1970 to January 1978. Regular monthly visits were begun in August 1976 when frequent pit trapping was carried out until the end of 1977. The technique of Matthews (1972) for the pit fall trapping of dung-attracted Coleoptera proved invaluable in ascertaining the district's scarabaeine, hybosorine and aphodiine fauna. Traps were baited either with human faeces or mushrooms. As the bait material often adhered to captured beetles, making field identification difficult, it was found desirable to enclose the bait in small cloth bags. These bags were sewn to a finished size of approximately 140 mm x 100 mm although the bag size was varied to match the trap cup size used. Some difficulty was experienced in inserting faecal material into a bag size of less than 100 mm in width. After placing the bait in bags the latter were tied off with thread about one third the way down from the open end, forming a roughly gathered area of cloth. When placed upside down into the trap cup this gathered cloth afforded the attracted Coleoptera a degree of protection from small forest preditors, especially Carabidae, which in wet forest habitats often enter traps. Lawn type materials, or light synthetics used in curtain making, were used to make the bags. Other collecting techniques included plant and blossom observation, sweep-netting, observation of town lights and tide marks (Williams, 1976). A 20 watt 12 volt "black" light, operated from a standard vehicle battery, was also utilized for the collection of species attracted to light.

Field notes of numbers collected provided an assessment of the abundance of each species encountered. In the following list "rare" indicates fewer than three specimens, "few" means three to ten specimens, and "common", more than ten specimens taken over the period of collection. Though "rareness" may be only a reflection of astuteness in observation, and not necessarily indicative of a species actual abundance, the need for such an assessment cannot be avoided.

List of species

APHODIINAE

Aphodius granarius Linnaeus–Nov.-Dec.; common at town lights.

Aphodius lividus Olivier–Nov.-Dec.; common at town lights, pasture and woodland.

Ataenius imparilis Blackburn– Nov.; rare on tide marks.

Ataenius macilentus Blackburn–Nov.; few at border of pasture and *Casuarina* swamp at light.

Ataenius tweedensis Blackburn–Oct., Feb.; common at light in heathland and woodland.

HYBOSORINAE

Liparochrus bimaculatus Westwood–Aug., Nov.-May; common at human faeces, rotting molluscs and fish in rainforest.

SCARABAEINAE

Onthophagus capella Kirby–Sept., Dec., Apr.; common at faeces and cowdung in woodland and pasture, rare on tide marks.

Onthophagus tabellifer Gillet–Sept.-Apr.; few in rainforest at human faeces. With the exception of one isolated individual in April males were only taken during December and January.

Onthophagus nurubuan Matthews–Sept., Oct., Dec., Apr., May; common at cowdung; rare at faeces in woodland-heath complexes.

Onthophagus auritus Erickson–Sept., May; few at faeces in woodland-heath complex.

Onthophagus waterhousei Boucomont and Gillet–Sept., Nov., Dec.; few at faeces in woodland-heath complex.

Onthophagus rubicundulus Macleay–Sept., Dec.-Feb., Apr.; common in rainforest; rarely (Sept.) in woodland-heath at faeces.

Onthophagus granulatus (Bohem)–Oct.; common in pasture.

Onthophagus depressus Harold–Nov.-Feb., Apr.; few at lights, faeces and cowdung in pasture, town area, woodland and *Melaleuca* swamp.

Diorygopyx asciculifer Matthews–Sept.-Aug.; common in rainforest at mushrooms, faeces and rotting fish.

Lepanus australis Matthews–Aug.-Mar.; common at faeces and fishbones, rare at mushrooms, in rainforest.

Notopedaria metallica Carter–Dec., Mar., Apr.; common (Dec.) at faeces in rainforest.

RUTELINAE

Repsimus manicatus manicatus (Swartz)–Nov., Dec.; common at town lights and by day on *Leptospermum* spp., common at tide marks, few at light adjoining rainforest.

Repsimus aeneus (Fabricius)–Dec.; common at lights, rare on tide marks.

Anoplognathus cloropyrus (Drapiez)–Dec.; common at tide marks and light in *Eucalyptus* woodland.

Anoplognathus olivieri (Dalman)–Nov.-Feb.; common at lights in woodland & on tide marks.

Anoplognathus pallidicollis Blanchard–Dec., Jan.; common on tide marks.

Anoplognathus porosus (Dalman)–Nov., Dec.; common at lights and tide marks.
Anoplognathus viridiaeneus (Donovan)–Dec.; rare at tide marks.
Paraschizognathus ocularis Carne–Oct., Nov.; common in pasture or woodland adjoining *Casuarina* and *Melaleuca* swamps; flying after dusk; at lights.

CETONIINAE
Diaphonia dorsalis Donovan–Dec., Jan.; common in flight by day, few at tide marks.
Eupoecila australasiae (Donovan)–Jan.; larva breeding in driftwood at river mouth; few.

DYNASTINAE
Cheiroplatys latipes (Guerin)–Sept., Dec., Jan.; common at light in woodland, few at town lights and rarely (Sept.) in rainforest.
Cheiroplatys solidus Carne–Jan.; rare, dead on beach dune.
Dipelicus duplex (Sharp)–Sept., Nov., Feb., Mar.; common at town light near dune system.
Heteronchyus arator (Fabricius)–Sept.-Nov., Feb., Mar.; common at lights, *Eucalyptus* woodland, pasture and lawn areas, few at tide marks.
Metanastes vulgivagus (Olliff)–Oct., Nov., Jan., Feb.; common on tide marks and in association with *Heteronchyus arator* (F.) at light in woodland-pasture areas; rare at town lights.
Pimelopus dubius dubius Blackburn–Dec.-Mar.; few at light, rainforest and heathland; rare in woodland.
Pimelopus porcellus crassus Blackburn–Nov., Jan.; rare at town light near dune system.
Cryptodus sp. near *passaloides* Germar–Jan.; rare at light adjoining rainforest.

MELOLONTHINAE
Automolius humilis (Blanchard)–Dec.; rare on tide marks.
Automolius valgoides Blanchard–Oct., Nov.; common on *Leptospermum* blossom in heath-woodland complex.
Haplopsis ?sp. n., near *rutila* Britton–Dec., Jan.; few at light in rainforest.
Heteronyx spp (four species)–Aug.-Feb.; common at town lights, heath, rainforest, tide marks and woodland.
Neoheteronyx sp.–Dec.; rare at town light.
Maechidius emerginatus Waterhouse–Dec.; rare on tide marks.
Maechidius stradbrokensis Lea–Feb.; few at light in heathland; rare at light in rainforest.
Phyllotocus basalis Lea–Dec.; rare on tide marks, few at light adjoining rainforest.
Phyllotocus macleayi Fisher–Dec.; rarely at town lights and tide marks.
Phyllotocus scutellaris Macleay–Oct., Nov.; few on *Leptospermum* spp in heath-woodland complex.
Rhopaea verreauxi Blanchard–Dec.; rare on tide marks.
Sericesthis geminata Boisduval–Nov., Dec.; few at town lights; common on tide marks.
Sericesthis antennalis Blackburn–Nov.; rare at light on pasture-*Casuarina* swamp border.
Sericesthis accola Britton–Nov.; rare at light on pasture-*Casuarina* swamp border.
Sericesthis nigrolineata Boisduval–Nov., Dec.; common on tide marks.
Scitala aureorufa Blanchard–Oct., Nov.; at light adjoining rainforest, heath and woodland; common.
Diphucephala sp.–Oct.; rare in *Eucalyptus* woodland.
Diphucephala sp.–Oct.; few in heathland.
Liparetrus discipennis Guerin–Oct.; few on *Leptospermum* blossom in woodland.

Discussion

As previously stated, the heath-woodland communities were burnt out in October 1976 and February 1977, the last fire burning all harbaceous and shrub cover in the study area. *Leptospermum*, in particular, suffered from the latter fire; very few plants had begun to regenerate by December 1977. *Xanthorrhoea* dominated the flowering species in the spring following the February fire in much of the woodland habitat where previously it had been unnoticeable amongst the

Leptospermum that normally predominated. Heavy rain inundated the area for two lengthy periods in the first half of 1977, stagnant water expanses covering the collection sites for months at a time.

Ataenius imparalis, *Automolius humilis*, *Anoplognathus viridiaeneus*, *A. pallidicollis*, *Rhopaea verreauxi*, *Maechidius emarginatus* and *Sericesthis nigrolineata* were represented by specimens found only at beach tide marks and the usefulness of this collecting zone cannot be overlooked. The occurrence of Coleoptera at Harrington on tide marks could not be associated with any apparent temperature or wind condition or interaction. It would seem that specimens land accidentally or are forced to do so by exhaustion or strong wind, on the water, and tides then concentrate them along tidal zones (Williams, 1976).

Cetoniinae are poorly represented in the species list, although a number of undetermined species were noted in flight; the difficulty of collecting this subfamily has been well documented by Lea (1914).

A number of significant distribution extensions have resulted from the Harrington study, mainly of species associated with the littoral rainforest in the area. These records are listed below. For the interest of readers the previously published distribution or nearest published locality for each species is noted. For more definitive distributions readers are referred to the individual papers cited.

Anoplognathus viridiaenues. South-east corner of Queensland and immediate Sydney region (Carne, 1957a). The author also collected this resplendent and rare species south of Nowra, N.S.W. and it would appear that it has a more extensive, although discontinuous, coastal range than previously thought.

Paraschizognathus ocularis. Kempsey, N.S.W. (Carne, 1974). This species was found in numbers flying after dusk across wet pasture areas west of Harrington. It appears to exhibit only a slight attraction to light. Carne (1958, 1974) lists the species as occurring in December and January.

Cheiroplatys salidus. Paterson, N.S.W. (Carne, 1976).

Dipelicus duplex. A discontinuous coastal distribution from Sydney to Brisbane (Carne, 1957b). At Harrington, the larval stages of this species may be associated with beach dunes. Adults have been noted only from lights in close proximity to such dunes and a number of partially emerged though atrophied adults, have been found there.

Pimelopus dubius dubius has been recorded from all states except the Northern Territory and New South Wales. This appears to be the first record from New South Wales (Carne, pers. comm.).

Pimelopus porcellus crassus. Published records from all states except the Northern Territory and New South Wales (Carne, 1957b). It is interesting to note that in the south of the continent *P. p. crassus* and *P. d. dubius* appear to inhabit a similar geographic range. Their coexistence at Harrington is perhaps not surprising.

Haplopsis ? sp., near *rutila.* Published records for this predominantly Western Australian genus have been represented in N.S.W. only by *H. ollifi* Blackburn from Inverell and *H. viridis* Blackburn "New South Wales" (Britton, 1957).

Specimens have been lodged with the Australian National Insect Collection, Canberra.

Diorygopyx asciculifer previously recorded from Wingham and the Barrington Tops region (Matthews, 1974). A number of beetles were briefly observed in daytime rolling faecal balls. The beetles constructed ovoid masses, approximately 7 mm x 4 mm, from faecal matter and then proceeded to adopt position 1, the pulling position as described by Matthews (1974), to roll the ovoid. Traps were occasionally placed in cleared grassed areas separating individual rainforest patches and as no specimens were taken in them it would appear that population interchange between rainforest pockets of this apterous species is not of common occurrence.

Lepanus australis. Batemans Bay and Clyde Mountain, southern New South Wales (Matthews, 1974).

Notopedaria metallica. Gibralter Range National Park (Matthews, 1976). Matthews (1976) does not record any representatives of the genus *Notopedaria* further south than Dorrigo, N.S.W.

Onthophagus waterhousei has previously been recorded from only montane habitats (Matthews, pers. comm.).

Onthophagus tabellifer. Gerringong, N.S.W. (Matthews, 1972). This record is mid way between its previous known range (south coast N.S.W.) and that of the closely related *O. ouratita* Matthews from the south-east Queensland - New South Wales border.

Onthophagus rubicundulus. McPherson Range, N.S.W. - Queensland border (Matthews, 1972). Matthews states that the species is not associated with rainforest but Allsopp (1975) has recorded it from rainforest at Ravensbourne in southern Queensland. It has only rarely been encountered in open forest at Harrington, its usual habitat.

The long term stability and continuance of the rainforest at Harrington is open to question. However, it was from these remnant stands that the more notable records have been made. The fragility of these rainforest stands because of their small size gives little hope for the survival of those species known only from this habitat should any residential or tourist development be undertaken within it in the Harrington - Crowdy Head area.

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A NOTE ON ASPECTS OF THE FLIGHT BEHAVIOUR OF *ANTITROGUS NOX* BRITTON (COLEOPTERA: MELOLONTHINAE)

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In his recent revision of the Australian Melolonthini, Britton (1978) indicated that adult *Antitrogus* species "fly for a very limited period (about ½ hour) at dusk on very few days in the year",

On 27th November 1977, the authors observed large numbers of *Antitrogus nox* Britton flying just before midday at Peats' Ridge, near the species type locality of Gosford, New South Wales. Individuals were seen to fly no more than 1 m above the ground in a slow and somewhat cumbersome manner, and to continue flying for the three or so hours we were in the area. The temperature at the time was approximately 27°C and the sky cloudless.

Vegetation at the site was scattered eucalypt woodland with *Hakea, Kunzea* and flowering *Angophora* and *Leptospermum* species dominating the shrub complex. The beetles appeared to stay close to and within an area of thick *Leptospermum* and *Kunzea* bushes. Although slow, their flight was very erratic making netting difficult amongst the foliage.

Visits had been made, in similar weather conditions, to Peats' Ridge on 20th November 1976 and 13th and 20th November 1977, but no flight activity was noticed on these previous occasions.

A small series was taken and a specimen lodged with the Australian National Insect Collection, Canberra.

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THE RELATIONSHIP BETWEEN *EUPLOEA CALLITHOE* BOISDUVAL AND *E. PHAENARETA* (SCHALLER) (LEPIDOPTERA: NYMPHALIDAE) IN NEW BRITAIN AND NEW GUINEA

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Introduction

The nominate species *Euploea callithoe* Boisduval and *Euploea phaenareta* (Schaller), although treated as conspecific by Corbet (1942, 1943), have been regarded as distinct by other authors (Carpenter, 1953; D'Abrera, 1971). Evidence based on the immature stages suggests that the races of these supposed species, which occur in New Britain and New Guinea, are conspecific but may be specifically distinct from the more western subspecies assigned by Corbet to *E. phaenareta*.

In accordance with the nomenclature of D'Abrera (1971), the following subspecies have been bred: *E. callithoe callithoe* Boisduval from the Brown River, Papua; *E. callithoe callithoe* form *durrsteini* Staudinger from eastern New Guinea; *E. callithoe callithoe* form *hansemanni* Honrath from the Sepik area of New Guinea; and *E. phaenareta unibrunnea* Salvin and Godman from New Britain. In each case the larval food plant is *Cerbera floribunda* (family Apocynaceae), a plant that bears long fleshy leaves and large purple fruit. Growing to a height of thirteen metres, this plant is found throughout Papua New Guinea and New Britain. The early stages and habits of all four insects are identical which leads me to conclude that they are conspecific. A single description of the life history will therefore suffice for all.

Life history and habits

The adults fly in the wet season and are only rarely seen when dry conditions prevail. Captured females will oviposit readily in cages, the larvae growing rapidly under caged conditions. Fourth and fifth instar larvae always resort to the darkest part of the cage in accordance with the natural larval habit of retiring to the lower part of a tree trunk after feeding. In this situation they are extremely well camouflaged. Under natural conditions the incidence of parasitism is fairly high. The photographs below were taken near Lae, P.N.G.

Larval food plant: *Cerbera floribunda.*

OVUM (Fig. 1).

Cream, slightly higher than wide, rounded on the top and slightly ribbed, oviposited on either side of the leaf. Ovum darkens before larva emerges after seven to eight days.

LARVA (Figs 2, 3).

First instar. Overall colour white; head black. Feeds on the edges of the leaf.

Second instar. Grey overall with shining black head; legs, prolegs and anal claspers white; two small tubercles on the second and third thoracic segments.

1

2

Fig. 1. Egg on a leaf of the food plant, *Cerbera floribunda.*

Fig. 2. Fifth instar larva at rest with protubercles lowered.

Third instar. Body white; head black with triangular markings; tubercles yellow, tipped with grey; spiracles black with a fine yellow line running beneath them; legs, prolegs and anal claspers grey.

Fourth instar. Overall colour bluish grey with fine broken lines forming bands; lateral surface around the spiracles suffused with yellow; protubercles large and fleshy, pink at the base, grey centrally and tipped white. In this and the following instar the larva abandons the leaves and stems after feeding and rests on the bark of the tree near the base, or at the fork of a limb, where it is well concealed by its colour.

Fig. 3. Fifth instar larva with protubercles erect.

Fig. 4. Pupa.

Fifth instar. The full grown larva is about 50 mm long. Overall colour mushroom with broken bands of white and black; head with black and white diamond-shaped markings; legs, prolegs and anal claspers grey. While feeding, or when aroused, the protubercles are held erect; when resting they are extended over the head in a forward and downward position.

PUPA (Fig. 4).

After resting at the base of the tree, the larva ascends to the upper branches and spins a silken pad on the underside of a leaf and hangs head downwards. Pupation is complete within 24 hours. At first it is yellow in colour but on hardening changes in a few hours to metallic gold. The pupa is large and bulbous, about 20 mm long. Eclosion takes place after 12 to 14 days.

Discussion

Corbet (1942, 1943) treats *E. phaenareta* (including *E. callithoe*) as a single widespread species occuring from Sri Lanka and Indo-China to the Bismarck Archipelago and the Solomon Islands. Descriptions of the immature stages are rare. Moore (1858, as *prothoe*; 1880-81, as *elisa*; 1890-92, as *corus*) describes and illustrates the early stages from Sri Lanka, and Fountain (1925-26 & unpublished) the form on Polillo Island in the Phillipines. The only other known published description of the life history is by Ribbe (1895) based on the material from Finschhafen, eastern New Guinea; the illustration of the caterpillar accompanying this work lacks the pair of tubercles on segment eleven shown by Moore and Fountaine. Additionally, according to Mr T. G. Howarth (pers. comm.) the larva of *E. phaenareta* in Malaya also bears these processes. Their apparent absence or reduction is of particular interest since they are invariably present and distinct in the caterpillars of all other known *Euploea* species (Morishita, 1977). The trend for reduction of the anal tubercles shown in all four races bred here may be an indication that they are specifically distinct from the more westerly forms.

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NOTES ON THE LEAF BEETLE *HALTICA IGNEA* BLACKBURN (COLEOPTERA: CHRYSOMELIDAE: HALTICINAE) AT LAKE COWAL, NEW SOUTH WALES

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Abstract

Observations on the occurrence and crepuscular flight of the leaf beetle, *Haltica ignea* Blackburn (Coleoptera: Chrysomelidae: Halticinae) are reported together with some notes on feeding and predation.

During ornithological studies at Lake Cowal from 1969 to 1977, notes were made on the leaf beetle *Haltica ignea* Blackburn.

From 1969 to the summer of 1970-71 the beetles were present in small numbers on water milfoil, *Myriophyllum verrucosum* Lindl., growing at the edge of the lake which was at high waterlevel. When the waterlevel dropped, water milfoil covered large areas which were previously covered with water. During March 1971 beetles congregated in countless numbers on cane grass, *Eragrostis australasica*, and lignum bushes, *Muehlenbeckia cunninghamii*, near areas covered with water milfoil, so that the plants appeared to be metallic blue and bronze-coloured.

The beetles crawled actively over the plants and copulation was observed. Some flew from plant to plant while others flew in from all directions. Feeding was observed only on the red-flowering water milfoil.

The beetles were not evenly distributed, but occurred in distinct congregations. A total of 14 of these congregations was observed over a shore length of 700 m. They consisted of bands between 30 and 75 cm wide and ranged in length from 3 to 18 m. Estimated numbers were between 7,000 and 75,000 beetles per congregation. Beetles could be scooped out of cattle hoof marks in mud by the handful. Those from a clump of cane grass, about 1 m^2 in area, occupied a volume of 12 l.

Since March 1971 beetles have been observed in large numbers each year from the beginning of August to the end of June. Their numbers varied with the waterlevel of the lake; when the waterlevel was low congregations were large (the largest, during October 1971, was estimated to consist of some 200,000 beetles), when the waterlevel was high congregations of up to about 1000 beetles were common.

Each year larvae occurred between October and May, in association with adults. The larvae fed close together on water milfoil which, when growing in mud, was grazed down to mud level. The larvae reached plants growing in shallow water by wriggling across the surface of the water. There plants were eaten off to waterlevel.

Between 84 and 209 larvae were counted per 100 cm^2 quadrats; the average count in 20 quadrats was 136. The largest congregation of larvae covered an area of 97 x 83 m during February 1972. Heavy mortality of larvae was observed after a flood covered the feeding areas.

Eleven species of birds were observed to feed among the beetles and larvae: white-faced heron, *Ardea novaehollandiae*; glossy ibis, *Plegadis falcinellus*; white ibis, *Threskiornis molucca*; spotted crake, *Porzana fluminea*; painted snipe, *Rostratula benghalensis*; masked plover, *Vanellus miles*; red-kneed dotterel, *Erythogonys cinctus*; black-fronted dotterel, *Charadrius melanops*; silver gull, *Larus novaehollandiae*; Australian magpie lark, *Grallina cyanoleuca*; and the Australian magpie, *Gymnorhina tibicen*. Examination of the stomach contents of these birds, collected while feeding amongst the beetles, showed that only the Australian magpie fed upon both larvae and adults. The other species fed mainly on Diptera larvae and other arthropods. Vestjens (1974) recorded that magpies eat arthropods which, like this leaf beetle, man would consider to be unattractive, e.g. ants and shield bugs.

Movements of beetles between one congregation and another were observed commonly during sunny and hot days. A crepuscular flight was observed at 'Cowal North' Station, about 500 m from the lake shore on September 21, 1977.

The first beetles flew from south to north, just before sunset, in a band about 400 m wide and about 5 to 8 m above the ground.

The numbers of beetles passing across a 10 m length strip of this band were estimated to be:

Time	Estimated number of beetles per minute	Flight direction
17.47 to 17.48 hr	10 to 100	north
17.49	1,000	north
17.49 to 18.08	10,000	north
18.08 to 18.14	10,000	west
18.14 to 18.17	1,000 to 500	west
18.17 to 18.19	500 to 100	west
18.19 to 18.22	100 to 25	west
18.22 to 18.23	5	west
18.24	0	–

The change of direction at 18.09 hrs was when the sun had set, and beetles flew directly towards the last light, at a height of about 2 to 2.5 m. Air temperature during the flight period was about 20°C.

Beetles were attracted in large numbers to light traps which were operated during each visit to the area.

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LIFE HISTORY NOTES AND DISTRIBUTION RECORDS FOR SOME QUEENSLAND BUTTERFLIES

By D. A. Lane
22 Drummond Street, Toowoomba, Queensland 4350

Collecting in the Cairns district and in the Burdekin River basin for short intervals during the past several years has produced some new distribution records and life history information for one hesperiid and four lycaenid species.

HESPERIIDAE

Neohesperilla xiphiphora (Lower)

One male was collected in the Bogie River district approximately 96 km west of Bowen, Queensland, on 30 Nov., 1970. This species was previously unknown south of the Cairns area. The specimen collected was extremely fresh, and appeared to have bred locally.

LYCAENIDAE

Jalmenus ictinus Hewitson

A series of this species was bred from the Bogie River district approximately 96 km west of Bowen, Queensland, during November to mid December, 1970. The food plant was *Acacia bidwillii* (Corkwood Wattle). A species of meat or mound ant attended the larvae and pupae.

J. ictinus has previously been recorded from as far north as Duaringa, central Queensland (Common and Waterhouse, 1972). The above record extends its known distribution by 450 km to the NNW. During January, 1977, the closely related *J. pseudictinus* Kerr and Macqueen was found breeding abundantly on a broad-leafed *Acacia* species in the eucalypt forest west of Kuranda, Queensland. However, there was no apparent sign of *J. ictinus* in this area, even though meat ant colonies occur intermittently. Both species have been known to breed in the one area, on separate trees, in the Millmerran district, south Queensland (J. Macqueen, pers. comm.).

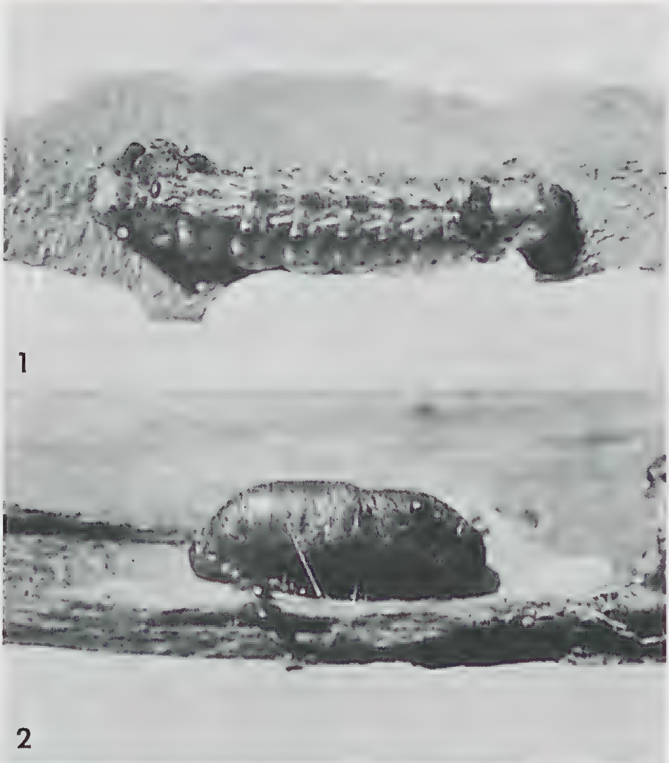
Compared with a series of *J. ictinus* bred from the Toowoomba area, the northern specimens were found to have some differences. On the upper side, the central blue areas of the fore and hind wings are paler, and the outer margins a much paler light brown; females have the terminal whitish markings on the hind wing more pronounced. Beneath they are similar to Toowoomba specimens but paler.

It is of interest to note that *Acacia bidwillii* has also been observed as a food plant of *J. daemeli* Semper in numerous localities between Rockhampton and Mackay, Queensland.

Ogyris iphis iphis Waterhouse and Lyell

(Figs 1, 2)

I first encountered the early stages of this species in January, 1977, approximately 15 km west of Kuranda, Queensland. The larvae were feeding on the mistletoe *Amyema miquellii* which was growing on a rough barked *Angophora* species prevalent in the open forest of this area. All larvae and pupae



Figs 1, 2. *Ogyris iphis iphis,* Kuranda, Queensland: (1) larva, final instar, with attendant ants *Froggatella kirbyi,* on a leaf of the food plant *Amyema miquellii*; (2) pupa, in lateral view, with cocoon on the right of a parasitic wasp that attacks the larva of this butterfly.

found were attended by the small black and tan ant, *Froggatella kirbyi.* This ant prefers to make its nest in hollow branches and borer holes, and it was in hollow branches that larger larvae and pupae were usually found. Young larvae generally stayed closer to the mistletoe clusters, even though the trees provided only small amounts of loose bark for concealment and protection.

Adult females were observed ovipositing at the base of the mistletoe clumps and on bare twigs within the clusters. Females were also observed feeding at the mistletoe blossom, while males were quite abundant on surrounding ridge tops. Numerous larvae and pupae were brought to Toowoomba and the insects emerged over a period from early February to mid April, 1977.

The larvae and pupae of *O. iphis* were very similar to those of *O. ianthis* Waterhouse from southern Queensland, which were being reared at the same time. As with larvae of *O. ianthis,* larvae of *O. iphis* will, after a period of time, refuse to feed without their attendant ants.

During two visits to Kuranda in January and May, 1978, *O. iphis* was found to be fairly widespread in the eucalypt forest west of Kuranda, and on this occasion was found breeding on the mistletoe *Dendropthoe vitellina* growing on a bloodwood species, as well as on *Amyema miquellii* which was growing on both *Angophora* and bloodwood trees.

Dendropthoe vitellina was also found to be the food plant of *O. iphis* in the eucalypt forest approximately 16 km west of Paluma, Queensland, during May, 1978. Here larvae were found under loose bark and in cracks in the trunk near the base of the tree.

Ogyris oroetes Hewitson

A small series of this species was reared from larvae and pupae taken approximately 20 km west of Kuranda, Queensland, during July and August, 1977. The food plant was *Amyema miquellii* growing on a eucalypt. During May, 1978, adults were collected flying in the eucalypt forest at Ellis Beach, north of Cairns, Queensland. At Ellis Beach, *Amyema miquellii* is a prevalent mistletoe species. *O. oroetes* has previously been recorded from as far north as Townsville in Queensland (Common and Waterhouse, 1972). Compared with specimens from southern Queensland, males from the Cairns-Kuranda area were found to have reduced outer black margins above.

Hypochrysops cyane (Waterhouse and Lyell)

During January, 1977, approximately 15 km west of Kuranda, Queensland, several adults were collected flying around a rough-barked *Angophora* species. These same *Angophora* trees supported clusters of the mistletoe *Amyema miquellii*, on which *O. iphis* was breeding. Adults of *H. cyane* were collected flying around the *Angophora* foliage, and several were also collected feeding at the mistletoe blossom.

The "skeletonised" appearance of some of the trees suggested that they might be the food plant, though a careful search on the foliage and in hollow branches revealed no trace of the life history. However, several colonies of the ant (*Iridemyrmex* sp.) which attends *H. cyane* in southern Queensland were present.

A single male has previously been recorded from Cairns by F. P. Dodd (Peters, 1969).

Acknowledgements

Thanks are extended to the staff of the Queensland Herbarium for identification of food plant specimens. I am grateful for the help and consideration given by Mr J. Macqueen, for the ready access given to his extensive collection and literature, and for his constructive criticism and suggestions concerning these notes. I am also grateful for the constructive criticism and suggestions offered by Mr M. S. Moulds.

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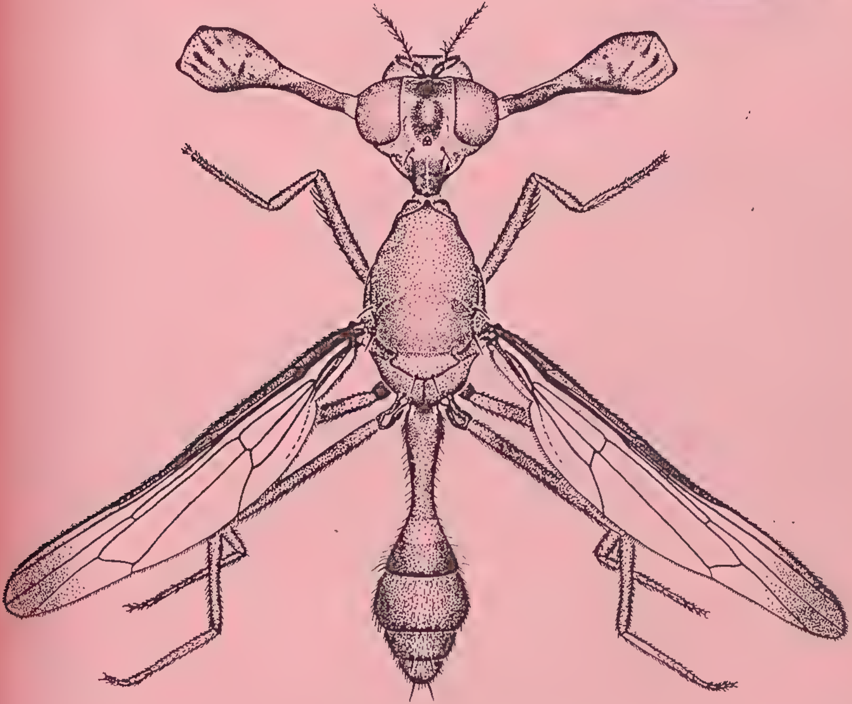

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COVER

Illustrated by Margaret Schneider.

This spectacular fly, *Phytalmia mouldsi* McAlpine and Schneider, is the sole representative of the genus in Australia. It is known only from the rain forests of the Iron Range district of Cape York Peninsula. Other species, some even more spectacular in appearance, occur in New Guinea and neighbouring islands. It is only the males that bear the amazing head projections which they use as contact areas when fighting for territorial and courtship rights.

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NOTES ON BUTTERFLIES FROM SOUTH BLACK RANGE, SOUTH-EASTERN NEW SOUTH WALES

By D. J. Ferguson
15 Bussell Crescent, Cook, A.C.T. 2614.

These notes are based on specimens captured in the vicinity of a large permanent marsh, in the South Black Range, at an altitude of approximately 1200 m, 8 km due east of Hoskinstown. The Black Range is a section of the Great Dividing Range lying about 45 km east by south-east of Canberra and is separated from the coastal range by the Shoalhaven River valley. To the north of Black Range the altitude of the Dividing Range falls sharply to about 760 m in the area of Lakes George and Bathurst. To the south the Dividing Range maintains an altitude of 1100 - 1220 m as far as the Brown Mountain area where it turns westward and again drops to an altitude of about 760 m near Cooma. The ranges between Black Range and Brown Mountain are separated from the Tinderry Mountains immediately to the west by the lower, drier valleys of the Queanbeyan and Bredbo Rivers.

Anisynta dominula draco Waterhouse

Common and Waterhouse (1972) record this subspecies from both Brown and Tinderry Mountains, and specimens from South Black Range also appear to belong to this race.

Adults were extremely common flying with *A. monticola* (Olliff) in the vicinity of the marsh in January and February. They were noticably less common elsewhere in the Range.

Hesperilla donnysa Hewitson

A small number of adults (some bred ex pupa) have been taken. These compare closely with specimens from the nearby Tinderry Mountains which are closely allied to the subspecies *donnysa* (Common and Waterhouse, 1972). The exact subspecific status has not yet been determined.

Oreixenica orichora orichora (Meyrick)

This species is generally a mid-summer to early autumn insect (McCubbin, 1971). Common and Waterhouse (1972) say it is the earliest species of *Oreixenica* on the wing, flying from December through to early February, although, in the Australian Capital Territory, Kitching *et al.* (1978) have only recorded it in January and February.

In South Black Range a large number of freshly emerged adults were first observed flying on 1 December 1977, from approximately 1100 m upward. Also encountered were a number of worn specimens in poor condition, possibly indicating that they had been on the wing for some weeks beforehand, possibly since early November. This unusually early occurrence could be attributed to the relatively warm and dry spring experienced that year, yet specimens in the Brindabella Range (west of Canberra) did not appear to be affected by this.

Specimens from Black Range compared closely in size with specimens from the Australian Capital Territory.

Oreixenica kershawi (Miskin)

Adults were observed commonly on 10 February 1978. The subspecific status of the Black Range specimens is uncertain. After comparison with specimens of *O. k. kershawi* and *O. k. phryne* in the Australian National Insect Collection and using the original description of *phryne* by Tindale (1949) (where comparisons were made with *kershawi*) they appear more closely related to *kershawi*. In addition, specimens from Black Range are similar to specimens from the nearby Brown Mountain - Nimmitabel area which Common and Waterhouse (1972) believe may prove to belong to *kershawi*.

Tisiphone abeona abeona (Donovan)

A brightly marked and possibly isolated colony has been observed in the area of the marsh where its food plant, *Gahnia* sp., grows abundantly. This colony extends the known range of this race westward from the Clyde Mountain-Monga area near Braidwood (pers. comm., E. D. Edwards).

Acknowledgements

Thanks are extended to Dr I. F. B. Common and Mr E. D. Edwards for helpful comments and suggestions and for allowing comparisons to be made with specimens under their care in the Australian National Insect Collection.

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THE WAX-EXUDING, CUTICULAR PORES OF *APIOMORPHA* RUBSAAMEN (HOMOPTERA, COCCOIDEA): A LIGHT MICROSCOPY AND SCANNING ELECTRON MICROSCOPY STUDY

By P. J. Gullan
Department of Zoology, Monash University, Clayton, Victoria

Abstract

The cuticular pores of adult females of the gall-forming genus *Apiomorpha* Rubsaamen are all multilocular disc pores that exude only curved filaments of white, powdery wax. The structure, distribution and wax exudation of these disc pores are described and discussed and a comparison is made between the appearance of the pores using light microscopy and scanning electron microscopy.

Introduction

The structure and distribution of wax-exuding pores of the adult female are used in the description and identification of coccid species (e.g. Ferris 1950, 1957; Beardsley 1959; Hoy 1962; McKenzie 1967; Miller 1970; Williams and Kosztarab 1972). Pores of several distinct structural types have been described (e.g. Ferris 1950; McKenzie 1967; Kawai and Tamaki 1967) and a few studies have associated particular pore types with the presence of certain types of wax (Kawai and Tamaki 1967; Tamaki, Yushima and Kawai 1969; Gimpel, Miller and Davidson 1974; Hamon, Lambdin and Kosztarab 1975). This paper is concerned with one type of disc pore and its exudation. Disc pores are classified as trilocular, quadrilocular, quinquelocular or multilocular, depending on the number of openings (loculi) that comprise each pore (Ferris 1950).

The conventional method for examination of cuticular details of coccids requires the preparation of cleared and stained specimens mounted on microscope slides (Kozarzhevskaya 1968). Scanning electron microscopy has also been used in several structural studies on the wax and the wax-exuding pores of coccids (Hashimoto and Kitaoka 1971; Miller and Gimpel 1974; Gimpel *et al.* 1974; Miller, Marsh and Gordon 1975; Miller 1975; Knipscher, Miller and Davidson 1976), but no direct comparison between the appearance of pores using the light microscope and the scanning electron microscope seems to have been published. Light microscopy investigations have mainly concentrated on the histology of the wax-producing glands (Pollister 1937; Lower 1957) or on the structural interpretation of different pore types using only slide-mounted specimens (e.g. Ferris 1950; McKenzie 1967; Kawai and Tamaki 1967).

This paper describes the structure, distribution and wax exudation of the disc pores of the gall-forming genus *Apiomorpha* Rubsaamen and compares the appearance of the pores using light microscopy and scanning electron microscopy.

Materials and methods

Adult females of six species*, *Apiomorpha conica* (Froggatt), *A. munita* (Schrader), *A. ovicola* (Schrader), *A. pharetrata* (Schrader), *A. strombylosa* (Tepper) and one new, undescribed species, were examined with the scanning electron microscope. Fresh specimens were killed in 70% ethanol. Preserved specimens had been stored either in 70% ethanol or in a lactic acid-ethanol mixture (Stroyan 1949). All were collected by the author. Each specimen was cut open three-quarters of the way around the body along the dorso-ventral line, cleared in cold 10% potassium hydroxide for 24 hours, washed gently in distilled water to remove all body contents and placed in a small petri dish with dorsum and venter opened out to lie adjacent, still connected to each other. A coverslip was placed over the preparation to keep the cuticle flat during subsequent dehydration and the specimen was then bathed for one hour in acid alcohol (see method of Williams in Kozarzhevskaya 1968).

The preparation of specimens for both the scanning electron microscope and the light microscope was identical until this stage. For the former, specimens were then dehydrated using ethanol, transferred to absolute amyl acetate via a graded ethanol-amyl acetate series, placed on a 2.8 cm diameter specimen stub and allowed to air-dry. Shrinkage was not a problem since the cuticle of the pore walls appears to be stabilized by sclerotization. Silver dag was used to improve contact between specimen and stub. Specimens were coated with gold for three minutes at 30 mA in a model SC150 Dynavac Sputter Coater and examined in a Cambridge Stereoscan S4-10 S.E.M. at an accelerating voltage of 20 kV. Photomicrographs were taken with Polaroid Type 665 positive/negative film.

For light microscopy, specimens were stained for 1-5 minutes in a 50% acid fuchsin stock solution in water, dehydrated in ethanol, transferred to xylene and mounted in canada balsam on microscope slides (a modification of Williams' method in Kozarzhevskaya 1968). Photomicrographs were prepared using bright field illumination on a Leitz Orthoplan microscope equipped with an Orthomat camera using Copex Pan Rapid film. Specimens were also examined using Heine phase contrast illumination.

Only the pores of the venter, especially the abdominal segments, were intensively studied, although the distribution and characteristics of all body pores were noted. Unless otherwise stated, the structural descriptions refer to ventral pores.

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* Collection data for specimens used in this study:– *A. conica* (Froggatt)–ex *Eucalyptus viminalis* Labill., Cranbourne Botanic Gardens Annexe, Cranbourne, Vic., 27.i.1977; *A. munita* (Schrader)–ex *E. goniocalyx* F. Muell. ex Miq., Mt Granya, *c.* 12 km NE Tallangata, Vic., 29.v.1975; *A. ovicola* (Schrader)–ex *E. camaldulensis* var. *obtusa* Blakely, Maloneys Creek, *c.* 6.5 km N Finke River and *c.* 110 km SW Alice Springs, N.T., 29.v.1977; *A. pharetrata* (Schrader)–ex *E. macrorhyncha* F. Muell. ex Benth., Mt Granya, *c.* 12 km NE Tallangata, Vic., 25.v.1976; *A. strombylosa* (Tepper)–ex *E. polyanthemos* Schauer in Walp., 134 Brackenbury Street, Warrandyte, Vic., 7.v.1977; *Apiomorpha* sp.–ex *E. leptopoda* Benth., Great Eastern Highway, *c.* 80 km E Southern Cross, W.A., 3.iv.1978.

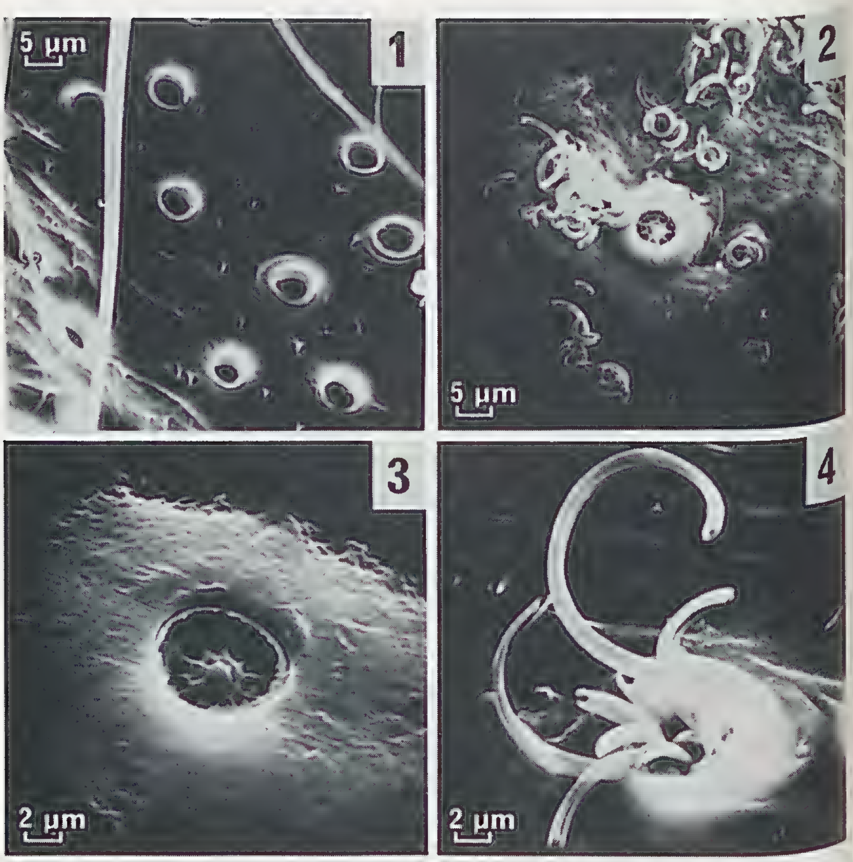
Pore structure and wax exudation

The wax-exuding structures of *Apiomorpha* are all multilocular disc pores, with locular numbers varying from 7 to 19. Nine-locular and 11-locular disc pores are most numerous on the dorsum and venter of *A. ovicola, A. pharetrata, A. strombylosa* and the undescribed species, particularly on the abdominal segments, while 11-locular and 13-locular disc pores occurred most commonly on the specimens of *A. conica* and *A. munita* that were examined. However, certain geographic populations of *A. munita* show a predominance of 7-, 9- and 11-locular disc pores.

Pore diameter, as measured from scanning electron micrographs, ranged from 3.0 µm for a few abdominal pores of *A. conica* (Fig. 1) to 8.0 µm for some pores of *A. ovicola.* The wax-exuding part of each pore is sunken below the rim to varying degrees, depending on the species, and in some species each pore is surrounded by a broad, raised rim that is more sclerotized than the surrounding cuticle (Fig. 2). The disc pores of *A. conica* are especially depressed and the rim is more flange-like than in the other species (Fig. 1). Each disc pore possesses a central, sclerotized, flattened (as in *A. conica*) or, more usually, convex structure (*A. munita, A. ovicola, A. pharetrata, A. strombylosa* and the undescribed species) that is encircled by the loculi (Figs 2, 3). Hence there is no central aperture to the disc pores of *Apiomorpha*, in contrast to the situation in some other coccids (Gimpel *et al.* 1974; Hamon *et al.* 1975). For instance Gimpel *et al.* (1974) state that the multilocular pores of the genus *Ceroplastes* Gray (Coccidae) possess a central, circular loculus.

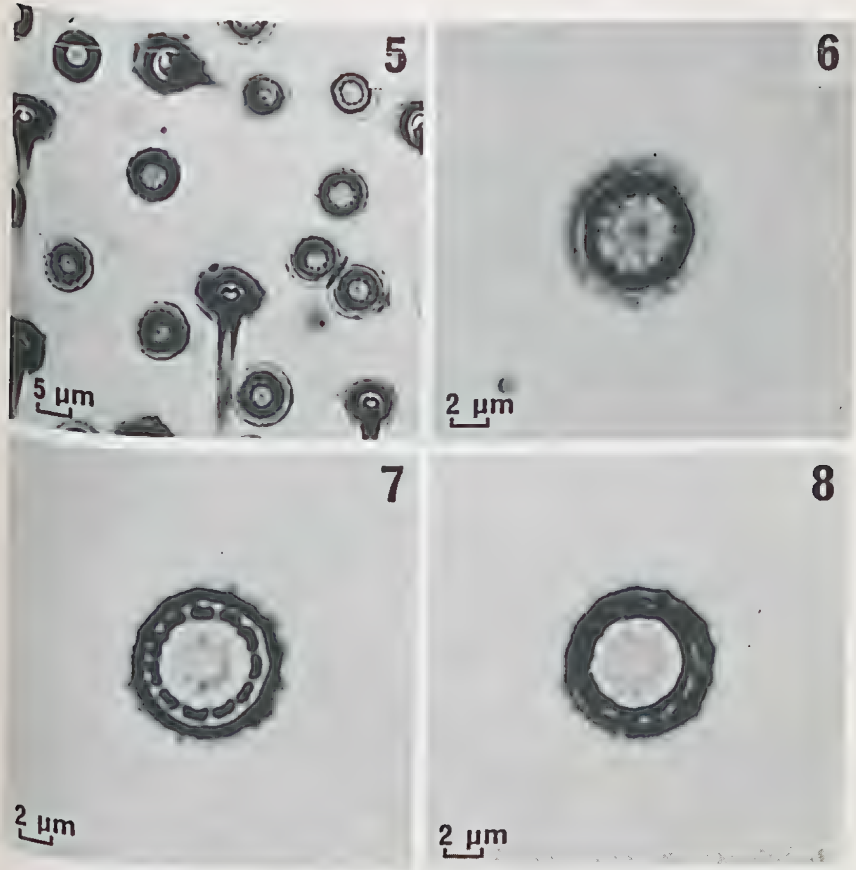
Each locule appears to exude a curved filament of wax (Figs 2, 4) that is trough-like or almost C-shaped in cross-section and about 1 µm in diameter. The structures that are just visible on the outer edge of the loculi of Fig. 3 are the truncate ends of wax filaments. The preparation technique probably dislodged the exposed filaments from most of the specimens examined. Wax was most often observed in specimens prepared from recently-killed individuals, especially those from species that were prolific wax-producers. These wax filaments are white and powdery in living specimens.

In the genus *Ceroplastes* the multilocular pores are mainly confined to the vulvar region and have been associated with the exudation of powdery or granular, white wax (Kawai and Tamaki 1967; Tamaki *et al.* 1969; Gimpel *et al.* 1974). In *Kermes kingi* Cockerell (Kermesidae), filaments of wax were presumed to be exuded by transverse abdominal rows of multilocular pores on the venter of the adult female (Hamon *et al.* 1975). These studies have suggested that powdery wax filaments, apparently exuded from multilocular pores, probably function to prevent eggs from adhering to each other and to the brood chamber and to protect eggs from desiccation. The chemical composition of the powdery wax has not been reported, but glands associated with multilocular disc pores of two coccids have been shown to be multicellular (Pollister 1937; Tamaki *et al.* 1969). The extrusion of wax filaments that is observed in *Apiomorpha* (Fig. 4) provides evidence that the powdery wax is actually exuded by loculi of the multilocular disc pores.



Figs 1-4. Scanning electron micrographs of ventral, abdominal, wax-exuding pores of *Apiomorpha* Rubsaamen: (1) multilocular pores and minute, spine-like processes of *A. conica* (Froggatt); (2) 9-locular pore and wax filaments of *A. ovicola* (Schrader); (3) 11-locular pore of *A. strombylosa* (Tepper); (4) pore of undescribed species in process of exuding wax filaments.

In adult females of *Apiomorpha* the multilocular disc pores generally occur on all body segments of the dorsum and venter, although pores are mostly absent from the ninth abdominal segment and are never present on the anal lobes. Both the surface of the adult female and the walls of the gall chamber are usually coated with white, powdery wax and the presence of this wax at the orifice of the gall, in many species, indicates that the gall houses a live insect. In species where the female has very few pores [e.g. *A. calycina* (Tepper)] a negligible amount of wax is present. Wax secretion does not appear to be closely associated with parturition in *Apiomorpha*, but probably prevents the female from becoming covered with its own honeydew excreta and may protect the female against



Figs 5-8. Light photomicrographs of ventral, abdominal, wax-exuding pores of *Apiomorpha* Rubsaamen: (5) *A. conica* (Froggatt)—an area similar to that of Fig. 1, but spine-like and hair-like setae present; (6) 7-locular pore of *A. ovicola* (Schrader); (7, 8) same 11-locular pore of *A. ovicola* at two different focal planes.

desiccation. The latter suggestion is supported by the observation that species in which the female produces very little wax possess galls with minute orifices, which would serve to restrict water loss from the gall cavity. The former function has been discussed by Broadbent (1951) in relation to gall-living aphids and it is notable that in *Apiomorpha* some wax-exuding pores are always present on the posterior abdominal segments, which are most likely to come into contact with excreta, while pores may be reduced in number or absent from the anterior of the body. In some other coccids (Williams 1978), instances of reduction in number or absence of the wax-exuding pores and ducts have been shown to be associated with the myrmecophilous habit. This possibly suggests that the wax secretion of at least some coccids functions chiefly to prevent contamination from the coccid's own honeydew rather than to prevent desiccation. A very close association with ants would reduce the need for a waxy covering because the ants would quickly remove any honeydew that was produced.

Pore structure

Light microscopy compared with scanning electron microscopy

Figs 5-8 are light photomicrographs, taken with bright field illumination, of well-stained disc pores that were observed on recently-moulted adult females of *A. conica* and *A. ovicola.* In mature specimens the general body cuticle is thicker and differential staining is difficult to achieve. The photographic quality of stained mature specimens and unstained material is poor and the use of phase contrast illumination does not significantly improve the image.

Light photomicrographs show the following inadequacies: the structure of disc pores is difficult to determine due to poor resolution (Figs 5, 6) and the image has a variable appearance due to limitations of focal depth (compare Figs 7 and 8). Figs 1 and 5, which are of similar areas of the abdominal cuticle of *A. conica* and at comparable magnification, demonstrate the improved resolution and greater depth of focus that is attainable with the scanning electron microscope. From the light photomicrograph (Fig. 5) the sunken nature of the disc pores is not apparent and the minute, spine-like, non-cellular processes of the body cuticle, that are seen clearly in Fig. 1, only appear as faint, darkish spots.

Disc pores of different locular number (compare Fig. 6 with Figs 7 and 8) may display apparent variation in structure that cannot entirely be attributed to differences in the focal plane. This variation may be due to disparity in the passage of light through loculi of different size.

The use of both the light microscope and the scanning electron microscope provides an integrated description of the wax-exuding pores. While light microscopy is essential for determining the distribution of disc pores of different locular number, a knowledge of pore ultrastructure allows the accurate description of pore structure and the interpretation of the conventional light microscope image. The value of the scanning electron microscope in determining the complicated structure of wax-exuding pores has been recognised by Tamaki *et al.* (1969), Miller and Gimpel (1974) and Miller *et al.* (1975). Furthermore Miller (1975) has suggested that pore ultrastructural differences may be useful for separating species.

Acknowledgements

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FIRST RECORD OF THE BUTTERFLY *PITHECOPS DIONISIUS DIONISIUS* (BOISDUVAL) (LEPIDOPTERA: LYCAENIDAE) FROM THE AUSTRALIAN MAINLAND

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Abstract

Nine specimens of *Pithecops dionisius dionisius* (Boisduval) (Lepidoptera: Lycaenidae: Lycaeninae) are recorded from Cape York Peninsula, northern Queensland. These constitute the first mainland records for this New Guinea butterfly, the only other Australian recording being from Darnley Island in Torres Strait.

Introduction

Pithecops dionisius (Boisduval) is a small, shade-loving lycaenid butterfly which is common and ubiquitous in New Guinea. Its inclusion in the Australian fauna has been on the basis of a single male from Darnley Island in Torres Strait between New Guinea and Australia (Waterhouse and Lyell, 1914). It has not previously been taken on the Australian mainland. Therefore it is of interest to record here the capture of nine specimens during 1977 at two widely-separated localities; Lockerbie Scrub and Iron Range, both in Cape York Peninsula.

Lockerbie Scrub is an area of rain forest situated approximately 7 km south of the tip of Cape York Peninsula and about midway between Bamaga near the west coast, and Somerset on the east coast adjacent to Albany Island. This area was extensively worked by European collectors during last century when Somerset was occupied. Iron Range is a more extensive area of rain forest located about 225 km south of Cape York and approximately 10 km inland from the east coast. Extensive collecting has occurred in the latter area in recent years (Monteith and Hancock, 1977).

Material cited

NORTH QUEENSLAND, CAPE YORK PENINSULA: 1 ♂, Lockerbie Scrub, 7-13.iv.1977, J. W. C. d'Apice; 2 ♂, 2 ♀, Iron Range, 15-20.iv.1977, M. Walford-Huggins (in J. W. C. d'Apice Collection); 2 ♂, Gordon's Creek, Iron Range, rain forest, 12.iv.1977, Anthony Hiller (in Anthony Hiller Collection and Australian National Insect Collection); 1 ♂, Lamond Hill, Iron Range, 4.vii.1977, G. B. Monteith (in Queensland Museum); 1 ♂, Iron Range, 20.v.1977, D. Binns, along road in rain forest (in D. Binns Collection).

Discussion

The treatment of the species in Seitz (1922) recognizes seven subspecies as follows:

Pithecops dionisius dionisius (Boisduval)	Throughout New Guinea
P. d. peridesma (Oberthur)	Northern Moluccas
P. d. euanthes Fruhstorfer	Southern Moluccas
P. d. bassaris Niceville	Key Islands

1

2

Figs 1, 2. *Pithecops dionisius,* upperside (left), underside (right): (1) ♂ from Lockerbie Scrub, 7-13.iv.1977, J. W. C. d'Apice; (2) ♂ from Gordons Creek, Iron Range, 12.iv.1977, Anthony Hiller.

P. d. staphylus Fruhstorfer	New Britain, Duke of York Islands and Kiriwina
P. d. oinopion Fruhstorfer	Shortland, Alu, Fauro, Florida and Tresor Islands
P. d. steirema Druce	Gaudalcanal

Waterhouse and Lyell (1914) describe the specimen taken on Darnley Island as belonging to the nominotypical subspecies and illustrate it in their Figure 279. The Australian material considered here (Figs 1-2) compares well with this specimen as well as with specimens in the collections of Dr A. Sibatani and Anthony Hiller taken in the New Guinea localities of Wau, Port Moresby, Sogeri, Tapini, Madang and the Morobe District. This is as one would expect, considering the proximity of Cape York to the New Guinea mainland.

The condition of the specimens taken on Cape York Peninsula indicates that they had recently emerged, thus negating the possibility of their being vagrants from New Guinea. The flight of this species is weak and slow (Fisher, 1977), not unlike that of the satyrid *Hypocysta angustata angustata* Waterhouse & Lyell, which also occurs at Iron Range. All specimens were taken along rain forest edges where they flew close to the ground.

Recent collecting at Iron Range has produced no more specimens of this lycaenid, but any collectors visiting the area in the future may be fortunate enough to locate it again. According to Fleming (1975), another species of this genus which occurs in Malaysia, *Pithecops corvus corvus* Fruhstorfer, has as its food plants *Gardenia florida* and Leguminosae. It is possible, therefore, that the larvae of *dionisius* will be discovered on plants of these groups in Cape York Peninsula.

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We wish to thank Mr G. B. Monteith and Mr E. C. Dahms, Queensland Museum, and Dr I. F. B. Common, CSIRO Division of Entomology, Canberra, for determining sexes of specimens, for photography and for valuable advice on this paper. We are also indebted to Maria Walford-Huggins for specimens from Iron Range, to Dr A. Sibatani for access to his collection for comparative purposes, and to Mr D. Binns for information on his specimen.

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EGG TYPES AND OVIPOSITION BEHAVIOUR IN SOME FULGOROID LEAFHOPPERS (HOMOPTERA, FULGOROIDEA)

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Abstract

The oviposition behaviour of *Scolypopa australis* (Walker) (Ricaniidae) is described in detail for the first time. The oviposition sites of *Kallitambinia australis* Muir (Tropiduchidae) and an unidentified achilid are described for the first time. Brief descriptions of the eggs of all three species are given.

The specialisations of oviposition behaviour found in the Fulgoroidea are discussed with respect to egg protection and related to the apparently long evolution of the superfamily.

Introduction

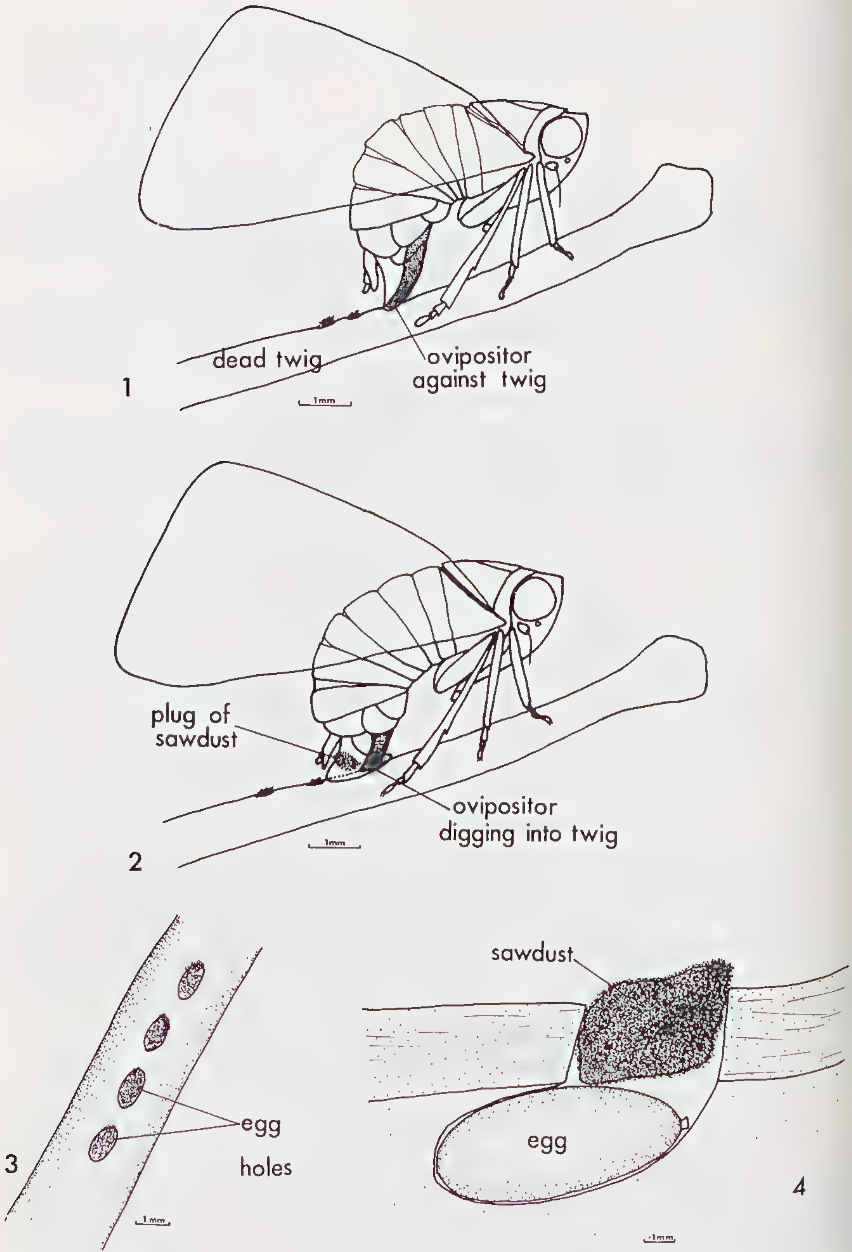
During embryological studies of Fulgoroidea, observations were made on egg types and oviposition of *Scolypopa australis* (Walker) (Family Ricaniidae), *Kallitambinia australis* Muir (Family Tropiduchidae) and an unidentified species of Achilidae.

Scolypopa australis (Walker)

This species is common on many different host plants in New South Wales, Queensland and New Zealand. Cumber (1966) described briefly its egg and oviposition sites and listed over twenty genera of plant hosts in New Zealand. In the present study it was found breeding on *Aegiceras corniculatum* (L.) (Myrsinaceae), the river mangrove, at Patonga, north of Sydney, N.S.W. This host plant has not previously been recorded for *S. australis.* The female prepares to lay by moving down the plant from the young mangrove shoots to dead twigs about 3 mm wide attached directly to a living branch. Rows of up to sixteen eggs are laid along the axis of the twig, though there are usually three to six eggs per row.

Detailed observations were made on the method of oviposition employed by one female which laid in the laboratory. The ovipositor consists of two pairs of cutting valves (first and second valves) surrounded by a pair of broad plates (third valves).

After the female had chosen a dead twig she lined herself up with the longitudinal axis of the twig and swayed slightly from side to side for three or four minutes. During this time her body was held raised from the surface and the apex of the abdomen held against the twig. The angle of the body to the twig was about ten degrees, whereas the abdomen was at an angle of 45° to the twig. The wings were held slightly higher and slightly steeper than usual (Fig. 1). The first and second pairs of ovipositor valves began to work their way into the twig. The second valves made a hole and as they withdrew the first valves were inserted. The two pairs of valves worked alternately in this manner for about ten minutes. As the hole was deepened and widened, the body of the female was lowered slowly towards the twig (Fig. 2). When the hole was deep enough the female raised her body again and the two sets of valves again worked their



Figs 1-4. *Scolypopa australis* (Walker): (1) female immediately before beginning to dig egg hole; (2) female with ovipositor inserted into egg hole, showing wad of sawdust held in third valves; (3) line of egg holes in twig; (4) structure of egg hole containing egg.

way into the hole shaping and enlarging it. Six more times the valves were pulled out and worked into the hole again before it was ready to receive the egg. After the eighth withdrawal the valves were inserted into the hole and the abdomen was contorted as the egg was laid.

At no time did the large third valves enter the hole. They were held around the edges of the hole and collected the sawdust as it built up from the digging action of the ovipositor. Due to the shape and position of the third valves, this sawdust was compressed into a column which was held by the third valves until after the egg was laid, when it was placed into the opening of the hole to cover the egg. The female then moved forward a short distance along the twig, still holding her abdomen at an angle to the body and immediately began to dig a new hole. Each hole was dug in exactly the same way as the first. The same number of "digs" were used to enlarge and shape the hole before the egg was laid. It took 18½ - 23 min. to lay each egg from the time the digging started to when the plug of sawdust was deposited in the hole. The first "dig" in each hole took 7 - 8 min. to complete. After the final egg had been laid the female walked a short way up the twig and flew away. Her abdomen was still full of eggs.

The same basic technique is obviously employed by all female *S. australis* as all oviposition sites examined were the same in structure and all matched the description of the sites by Cumber (1966). Each row appears to the eye as a line of small pale spots along the axis of the twig (Fig. 3). The structure of each hole was described by Cumber (1966) and is illustrated in Fig. 4.

Twigs approximately 3 mm wide attached directly to living tissue are the only ones selected by the female and she does not choose thicker dead twigs which have suitably-sized twigs branching from them. Consequently, when the nymphs hatch they will be quite close to living tissue and, presumably, their first meal of sap. It is unknown what method the female uses to check the twigs. Cumber (1966) stated that oviposition sites on the several plant hosts he examined were usually in soft stems which subsequently hardened and died. He suggests that the subsequent dieback of the twigs may have been initiated by the plant prior to the insertion of the eggs.

The eggs are ovoid, uniformly translucent and with a mushroom-shaped micropylar cap at the anterior end. The length varies from 770 µm to 870 µm and the width across the widest part, which occurs about midway along the length, is 360-380 µm. The dorsal surface is slightly more convex than the ventral surface.

Kallitambinia australis Muir

Few aspects of the biology of this species were known and no biological information has appeared in the literature. The species has been taken along the eastern coast of Australia between Brisbane, Queensland, to just south of Sydney, N.S.W., and appears to live principally on *Aegiceras corniculatum* (L.) (Myrsinaceae), the river mangrove, on which it was found at Patonga, N.S.W. during the present study.

Eggs of *K. australis* are laid in rows of up to eleven in the thick leaf margins of living leaves of *A. corniculatum.* Each is laid from the ventral surface of the leaf with the anterior end facing inwards. There is no covering placed over the egg in the hole so that the operculum on the dorsal side of the anterior end of the egg is left exposed (Fig. 5). No detailed observations have been made on the method of oviposition employed by the adult female. After the row of eggs has been laid, the damaged portion of the leaf margin dies and hardens forming a brown casing which probably helps protect the eggs from mechanical damage.

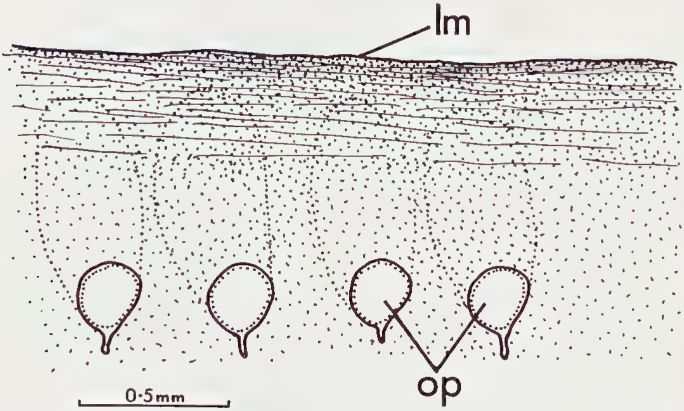


Fig. 5. Eggs of *Kallitambinia australis* Muir in situ in ventral surface of mangrove leaf. lm., leaf margin; op., operculum.

The eggs are ovoid, uniformly translucent, with an elongate, dorsally-curving peg-like micropylar cap anteriorly and a circular operculum anterodorsally. The egg, on laying, is 660-720 µm long and 279-306 µm wide at the widest point. The dorsal surface is less strongly convex than the ventral surface, which is more strongly convex towards the posterior end than anteriorly.

Unidentified Achilid*

The adult of this species was found in large numbers on an Australian native pine, *Callitris muelleri* (Parlot) (Cupressaceae) at Pearl Beach, north of Sydney, N.S.W. in October, 1974. Attempts to place the species in a genus were unsuccessful. Like most Achilidae, the female possesses only short fleshy ovipositor valves incapable of inserting eggs into a woody plant. A detailed study of the leaves, stems, branches, fruits and bark of the pines revealed no eggs.

Initially, females with abdomens full of apparently mature eggs and with spermathecae filled with spermatozoa would not lay in the laboratory. After a number of unsuccessful attempts to get females to lay, it was found that access to a piece of bark was necessary. A piece of *Callitris* bark was placed into each of several tubes containing live females and in all cases females began laying eggs within two days. Each egg was coated with small pieces of bark material and dropped to the bottom of the tube in which it was laid.

* Specimens have been deposited in the collections of the Biological and Chemical Research Institute, Rydalmere.

The eggs were ovoid, slightly smaller than those of *Scolypopa australis* and with a large quadrangular micropylar cap at the anterior end. There were no other chorionic adornments.

In the field the female hopper coats the eggs in a similar way before dropping them into leaf litter. The camouflaged eggs were very similar to small pieces of vegetable matter and were extremely difficult to find in the leaf litter under the plant.

Covering the eggs in this way is presumably a means of protecting them either from parasitism, predation or from dehydration as they lie in the upper layers of the leaf litter.

Discussion

The eggs of Fulgoroidea are of various shapes, but frequently ovoid, and are laid in a variety of situations. Some have chorionic adornments, such as micropylar caps or opercula.

Previous workers have described the eggs and/or oviposition sites of *Siphanta acuta* (Walker) (Muir and Kershaw, 1912), *Melicharia unicolor* (Walker) (Grylls, personal communication), *Platybrachys leucostigma* (Walker) and *Platybrachys maculipennis* (LeGuillou) (Hacker, 1924), *Perkinsiella saccharacida* Kirkaldy (Kirkaldy, 1906), *Oliarus felis* Kirkaldy (Hacker, 1925), *Pyrilla perpusilla* Walker (Sander, 1956) and *Pyrops candelaria* (L.) (Kershaw, 1910). These species represent the fulgoroid families Flatidae, Eurybrachidae, Delphacidae, Cixiidae, Lophopidae and Fulgoridae.

The present work, in which the eggs of *Scolypopa australis, Kallitambinia australis* and an unidentified species of Achilidae have been described, adds the families Ricaniidae, Tropiduchidae and Achilidae to the list. In all species described the oviposition behaviour is somewhat specialised. In the two species which lay their eggs in the ground (*Oliarus felis* and the unidentified Achilid), care is taken to ensure that the eggs are adequately protected. *O. felis* covers the eggs with a waxy secretion to protect them from salt water at high tides, since this species lives below high water mark on the roots of salt water couch grass (Hacker, 1925). The achilid protected its eggs with pieces of bark as described above. The females would not lay in the laboratory until bark was provided for them.

Eggs laid into living plant tissue are usually covered with a waxy cap to prevent dessication and possible hardening and contraction of the plant. *K. australis* and *P. leucostigma* has each adapted to a single species of plant. *K. australis* required the thick leaf margins of *Aegiceras corniculatum* as discussed above and *P. leucostigma* the characteristic bark type of *Eucalyptus maculata* (Hacker, 1924).

S. australis lays its eggs into dead tissue (in this study) and covers them with a plug of sawdust. It also appears to select only those twigs which are close to living parts of the plants. Cumber (1966) suggests that when living tissue is selected it may be tissue in which the sap flow is reducing. *M. unicolor* appears to have similar oviposition habits to those of *Scolypopa australis* (Grylls, personal communication).

Such a diversity of behaviour patterns and specialisations indicates long evolution. Comparative study of the structure of the ovipositor suggests the same. Those species that insert their eggs into the plant itself have a strong, sclerotized, toothed ovipositor. These species are *P. saccharacida, M. unicolor, S. australis* and *K. australis*. The other species, *S. acuta, O. felis, P. leucostigma, P. perpusilla* and *P. candelaria* have short ovipositors, sometimes only a series of soft lobes whose main function is to manipulate the egg into the right position and then spread any waxy covering. It is of interest to note that *Melicharia unicolor* and *Siphanta acuta,* although belonging to the same family (Flatidae), have quite different oviposition behaviour.

Such morphological variation can only be reached by long evolution and is associated, in the Fulgoroidea, with specialisation of oviposition habits.

Acknowledgements

Thanks are due to Mr Norman Grylls, C.S.I.R.O. Division of Entomology, Canberra, for discussions concerning the flatid species involved and to Miss Bethelle Heuer for typing the manuscript.

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Although dated 1974 this title was not published until 1975. While I have been unable to determine the exact date of publication it was almost certainly during March 1975. The publisher has informed me that no records are kept by them relating to the dates of release of their books. The printers, however, have advised that they did not ship stocks of this book from their Hong Kong factory until December 1974. Requests for accession dates from major libraries revealed that the earliest acquired copy was one purchased by the State Library of Victoria, Melbourne, registered on 13th March 1975. Mr A. J. Fraser, manager of Australian Entomological Supplies, Sydney, has advised that copies ordered in 1974 were not delivered until March 1975, the publisher's invoice being dated 5th March 1975. The author of the book has confirmed that the date of publication was about this time and adds that there was an additional delay after copies arrived in Australia because of the necessity to reprint the dust jacket.

It is interesting to note that the book was reviewed in the December 1974 issue of the *Victorian Ent.*, 4(6): 82-83. and that this issue did in fact appear in December 1974. This anomaly can be explained. I wrote to Mr D'Abrera concerning this matter and he replied saying that some advanced review copies of the book were forwarded to the publishers by the Hong Kong printers. The review in question, although unsigned, was written by W. N. B. Quick who, at that time, was Acting Editor of the *Victorian Ent.* Mr Quick tells me that following receipt by him of his advanced review copy in December 1974 he was able to immediately write the review and include it in the journal's December issue he was then preparing. The *Victorian Ent.* was then in cyclostyled form and also at that time Mr Quick was cutting the stencils, duplicating, and stapling the issues himself. Hence the ability to publish the review so quickly. The exact price of the book was then unknown and is quoted in the review as 'about $12'. The book finally sold at $12.95.

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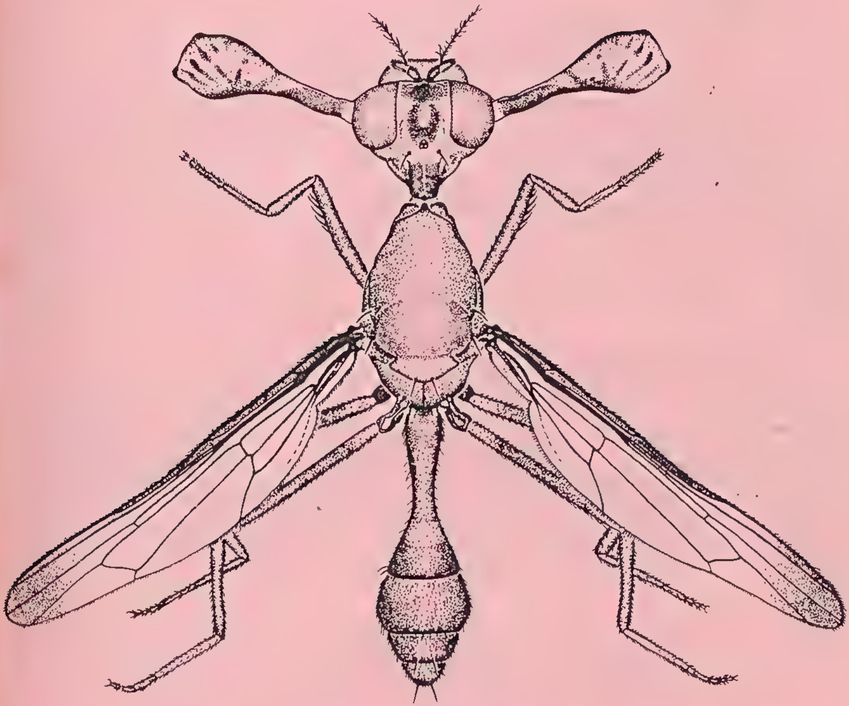

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COVER

Illustrated by Margaret Schneider.

This spectacular fly, *Phytalmia mouldsi* McAlpine and Schneider, is the sole representative of the genus in Australia. It is known only from the rain forests of the Iron Range district of Cape York Peninsula. Other species, some even more spectacular in appearance, occur in New Guinea and neighbouring islands. It is only the males that bear the amazing head projections which they use as contact areas when fighting for territorial and courtship rights.

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AN ADDITIONAL RECORD AND KEY TO THE PSOCOPTERA (INSECTA) OF LORD HOWE ISLAND

By C. N. Smithers
The Australian Museum, Sydney.

Smithers and Thornton (1975) listed nine species of Psocoptera from Lord Howe Island. Surprisingly, the list did not include any species of *Ectopsocus* McLachlan, a large, cosmopolitan genus some species of which have a very widespread distribution. Some develop very large populations, the usual habitat for the genus being dried leaves or leaf litter. Collecting in 1977 revealed the presence on Lord Howe of *Ectopsocus punctatus* Thornton and Wong (1968) which was beaten from dried leaves. *E. punctatus* was described from New Zealand and is known to occur also in eastern Australia (Smithers, 1977).

Material examined. LORD HOWE ISLAND: 2♂, from dried leaves, Mully Drive, 3-8.ii.1977 (C. N. Smithers).

Smithers and Thornton (1975) did not provide a key to the species of Psocoptera from Lord Howe Island. With the likelihood of increased entomological research on the island it would seem appropriate to present such a key here. Identifications made with its aid should, of course, be checked against full species descriptions.

KEY TO PSOCOPTERA OF LORD HOWE ISLAND

1. Fore wings acuminate, bearing scales 2

– Fore wings with rounded apex, without scales 3

2. Fore wings short (1.8 mm), somewhat thickened; hind wings reduced to small rudiments . . . . *Echmepteryx anomala* Smithers & Thornton

– Fore wings long (2.4 mm), not thickened; hind wings normal . . . . *Echmepteryx howensis* Smithers & Thornton

3. M in fore wing 2-branched 4

– M in fore wing with more than 2 branches 5

4. Fore wing membrane setose in distal part of cell R$_3$; cell IA pale . . . . *Pseudoscottiella hollowayi* Smithers & Thornton

– Fore wing without setae on membrane in distal part of cell R$_3$; cell IA dark . . . . *Pseudoscottiella fasciata* Smithers & Thornton

5. M in fore wing at least 4-branched . . . . *Pentacladus marmoratus* Smithers & Thornton

– M in fore wing 3-branched 6

6. Tarsi 2-segmented 7

– Tarsi 3-segmented 8

7. Areola postica present (i.e. Cu$_1$ branched) . . . . *Caecilius quercus* Edwards

– Areola postica absent (i.e. Cu$_1$ not branched) . . . . . *Ectopsocus punctatus* Thornton & Wong

8. Fore wing with dark areas along all distal branches of main veins; each flagellar segment dark with pale tip . . . . *Aaroniella howensis* Smithers & Thornton

– Fore wing membrane pale adjacent to distal branches of main veins; flagellar segments not pale-tipped 9

9. Wing membrane adjacent to apex of areola postica dark; hind wing margin with few fine setae between R$_{2+3}$ and R$_{4+5}$; Cu$_1$ in hind wing strongly recurved near wing margin . . . . *Spilopsocus parvus* Smithers & Thornton

– Wing membrane adjacent to apex of areola postica pale; hind wing margin setose along most of length; Cu$_1$ in hind wing not strongly recurved near wing margin . . . . *Haplophallus tandus* Smithers & Thornton

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FIRST RECORD OF *HYPOCHRYSOPS CLEON* GROSE-SMITH (LEPIDOPTERA: LYCAENIDAE) FROM AUSTRALIA

By D. P. A. Sands, M. De Baar *and* S. J. Johnson
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74 Guy Street, Warwick, Queensland, 4370

Abstract

Specimens of *Hypochrysops cleon* Grose-Smith were collected in Australia for the first time at Iron Range, northern Queensland.

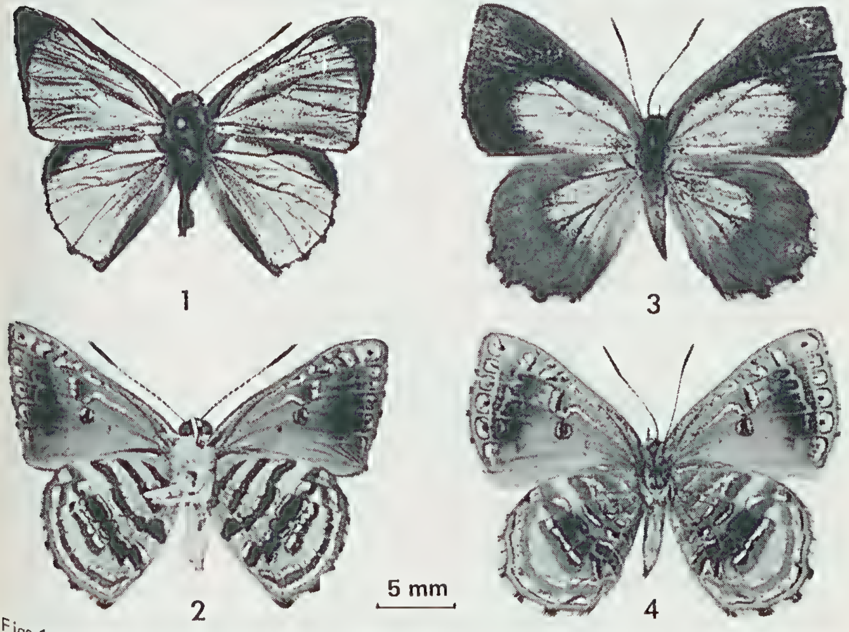
Introduction

On a visit to the Iron Range area of northern Queensland in June, 1978, two of us (M. De B. & S. J. J.) collected 10 males of a *Hypochrysops* species. These have been identified as *H. cleon* Grose-Smith by comparison with males and females from Papua New Guinea and the Aru Islands and the holotype in the British Museum (Natural History).

Abbreviations for museums and collections are as follows: ANIC, Australian National Insect Collection, CSIRO, Canberra; BMNH, British Museum (Natural History); DPAS, D. P. A. Sands collection, Brisbane; AM, Australian Museum, Sydney; MDB, M. De Baar collection, Brisbane; SJJ, S. J. Johnson, collection, Warwick, Queensland.

Material examined

AUSTRALIA: Iron Range, 10 ♂♂ (1 ♂, ANIC; 1 ♂, DPAS; 4 ♂♂, MDB; 4 ♂♂, SJJ); PAPUA NEW GUINEA: Gabensis, Morobe Province, 1 ♂ (ANIC); Bisianumu, Central Province, 1 ♂ (ANIC); Booboomia, Aroa River, Central Province, 1 ♂ (BMNH); Haldana, Collingwood Bay, Northern Province, 1 ♂ (BMNH); Kokoda Trail, Central Province, 1 ♀ (ANIC); Milne Bay, Milne Bay Province, the holotype ♀ (BMNH); ARU ISLANDS: 5 ♂♂, 3 ♀♀ (AM).



Figs 1-4. *Hypochrysops cleon* Grose-Smith: (1) male from Iron Range, northern Queensland, upperside; (2) the same, underside; (3) female from Aru Islands, Indonesia, upperside; (4) the same, underside.

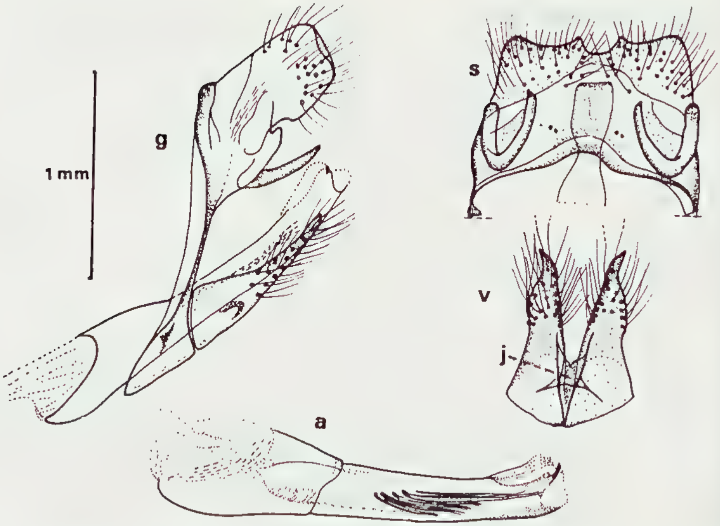


Fig. 5. *Hypochrysops cleon* Grose-Smith, genitalia of male from Iron Range, northern Queensland: a, aedeagus; g, lateral view, genitalia unmounted; s, sociuncus; j, juxta and v, valvae from slide preparations.

Discussion

The holotype female of *H. cleon* was collected at Milne Bay, Papua New Guinea (Grose-Smith, 1900). D'Abrera (1978) listed *H. cleon, H. cleonides* Grose-Smith, *H. hermogenes* Grose-Smith, *H. pretiosis* Grose-Smith and *H. thesaurus* Grose-Smith all as subspecies of *H. protogenes* C. & R. Felder, and followed the tentative arrangement of specimens in the collection of the British Museum (Natural History).

Identification of the females of the *protogenes* species complex has been difficult because of the similarity, variability and scarcity of specimens. The holotype specimens of *H. cleon, H. cleonides, H. pretiosis* and *H. protegones* are all females and distinctive specific features of the female genitalia have not been found (Sands, unpublished observations). The male genitalia of *H. cleon* (Fig. 5) are distinctive, and the sexes can be associated and distinguished from other species by the underside wing pattern (Figs 2, 4). The glistening violet colouration of the upperside of males (Fig. 1) is unlike the duller purple of males of *H. protogenes.* Specimens from Iron Range show some variability in the extent of patches of cream colouration between the bands of the underside of the hindwing.

All the specimens collected at Iron Range were taken as they settled about 8-10 metres from the ground on a small tree growing on a ridge close to Lamond Hill.

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We are grateful to Dr C.N. Smithers, Australian Museum, Sydney, Dr I.F.B. Common, CSIRO, Division of Entomology, Canberra, and Mr R. I. Vane-Wright, British Museum (Natural History), London for permitting examination and loan of specimens in the respective museum collections. Dr E. M. Exley and Mr E. D. Edwards kindly commented on the manuscript and Mrs S. Sands prepared the genitalia illustrations for publication. This study formed part of a post graduate programme carried out by D. P. A. Sands at the Department of Entomology, University of Queensland.

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ODONATA FROM CARNARVON GORGE, QUEENSLAND

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Abstract

Twenty seven species of Odonata are known from Carnarvon Gorge, eight Zygoptera and 19 Anisoptera; they constitute an outlier of the fauna of south-eastern Queensland and north-eastern New South Wales. Fourteen species are stream dwellers, and all but one of these have southern affinities. The gorge is the northernmost known locality of two of these southern species. Six species occur in the tributaries but not in the main gorge; two of these are known only from the Carnarvon Gorge area, and the other four show minor differences from their counterparts elsewhere in Australia.

Introduction

Carnarvon Gorge lies on Carnarvon Creek, a permanently flowing headwater of the Mackenzie River, which joins the Fitzroy River in central Queensland. At approximately 25°S, 148°E, it is some 130 km west of the inland border of the well-watered, montane region of south-eastern Queensland, as defined by Watson (1974), well into southern inland Queensland. Watson (1974) noted that an outlier of the south-eastern Queensland odonate fauna occurs at the Gorge, and excluded those south-eastern species from the faunal list for the more inland region. However, it was then clear that Carnarvon Gorge would repay further study.

The opportunity was therefore taken in December, 1976, to visit the Gorge, and G. Theischinger with L. Müller, of Sydney, spent the first three days of the month collecting adults and exuviae along the main gorge and some of the tributaries. An account of one species has already appeared (Theischinger, 1977) and another will be described elsewhere, in a paper on the Australian brachytronine aeshnids (Theischinger, in preparation). In this paper we discuss the fauna, and its affinities.

The fauna

Altogether, 27 species of Odonata were collected, eight Zygoptera and 19 Anisoptera; they are listed in Table 1, which also indicates their distributions in the Gorge area. Undescribed species are listed under the initial letter of their manuscript name, as in Watson (1974) or Theischinger (in preparation). It is most unlikely that this total is complete; at least a dozen other species might be expected to occur at the Gorge, to judge from their known distributions elsewhere in Australia (*cf.* Watson, 1974), but the species that were collected constitute an extremely interesting assemblage.

Two of the species were unknown previously, *Austroaeschna* sp. "m" and *Eusynthemis deniseae*; they appeared to be confined to the ravines of tributaries of Carnarvon Creek, and there they were the predominant dragonflies. The closest relative of *Austroaeschna* sp. "m" is *Austroaeschna pulchra* Tillyard [= *A. unicornis* (Martin) of recent authors] (Theischinger, in preparation), but *E. deniseae* shows almost equal affinities with the four other known species of *Eusynthemis* (Theischinger, 1977).

The other four of the six species found only along the tributary creeks all show minor differences from populations elsewhere. Pale markings on the end of the abdomen of most of the species occurring in the dark ravines are more extensive. Specimens of the three damselflies, *Argiolestes icteromelas*, *Episynlestes albicauda*, and *Synlestes tillyardi*, are larger than material from other localities. The *A. icteromelas* are larger than those from the high country of New England, described by Tillyard (1913a) as *A. icteromelas nobilis.* Males from Carnarvon Gorge had hindwings measuring from 32.0 - 32.9 mm, and females 33.7 - 34.2 mm; three male paralectotypes of *A. icteromelas nobilis* from Ebor and Dorrigo, now in the ANIC, measured 29.9 - 31.7 mm; and other material of *A. icteromelas* from New England and the Granite Belt of south-eastern Queensland, also in the ANIC, had hindwings ranging from 28.3 - 30.6 mm in males, and 29.0 - 31.3 mm in females. The hindwings of male *Episynlestes albicauda* from Carnarvon Gorge measured 30.8 - 33.8 mm, and of females 32.5 - 34.1 mm, compared with 28.1 - 31.5 mm and 29.9 - 33.1 mm in specimens from elsewhere (Watson and Moulds, 1977). The adult *Synlestes tillyardi* appeared similar to southern material in colour pattern, and in the general form of the male superior appendages, but the male hindwings were 32.6 - 33.6 mm long, and the female 35.0 - 35.6 mm, compared with 29.4 - 31.9 mm in a sample of males from the New England Tablelands, and 31.5 - 34.3 mm in a sample of females.

The material of the fourth species, *Eusynthemis nigra*, cannot be placed subspecifically, because *E. nigra* appears to change clinally from north to south, rather than to show the discrete differences that Tillyard (1913b) used to delimit northern and southern subspecies. The Gorge specimens differ from both northern and southern *E. nigra* in colour pattern, and have a slightly broader frons.

Austroaeschna unicornis speciosa [= *A. speciosa* Sjöstedt, and partly *A. longissima* (Martin) of recent authors (Theischinger, in preparation)] apparently differs from the typical form, but resembles series from south-eastern Queensland, at Tamborine Mountain and near Kenilworth. It was found breeding only in larger, deeper pools along the broad, shallow, stony waters in the main gorge, but the adults frequently visited the tributaries.

The remaining 20 species all frequented the main gorge, and none shows differences from its counterparts elsewhere in Australia.

Zoogeography

The geographical ranges of the Carnarvon Gorge Odonata, except for the two new species, are summarised in Watson (1974, 1977). All occur in south-eastern Queensland; three (*Synlestes tillyardi, Diphlebia nymphoides*, and *Austrogomphus* sp. "c") are not known to extend north of south-eastern Queensland; and only one (*Austroaeschna unicornis speciosa*) is not known from northeastern New South Wales (Watson, 1974, 1977; Theischinger, in preparation).

At least 11, and probably 13, of the 25 Gorge species known from elsewhere have wide ranges not closely related to the streams of the coastal

TABLE 1. Distribution of Odonata in the Carnarvon Gorge area.

species	representation			
	main gorge		tributaries	
	larvae	adults	larvae	adults
Suborder ZYGOPTERA				
COENAGRIONIDAE				
Austroagrion cyane (Selys)		*		
Pseudagrion ignifer Tillyard		*		
P. microcephalum (Rambur)		*		
MEGAPODAGRIONIDAE				
Argiolestes icteromelas Selys			*	*
LESTIDAE				
Austrolestes leda (Selys)		*		
CHLOROLESTIDAE				
Episynlestes albicauda (Tillyard)			*	*
Synlestes tillyardi Fraser			*	*
AMPHIPTERYGIDAE				
Diphlebia nymphoides (Selys)		*		
Suborder ANISOPTERA				
GOMPHIDAE				
Austrogomphus amphiclytus (Selys)		*		
Austrogomphus sp. "c"		*		
Hemigomphus gouldii (Selys)		*		
AESHNIDAE				
Aeshna brevistyla Rambur		*		
Austroaeschna sp. "m"			*	*
A. unicornis speciosa Sjöstedt	*	*		*
Hemianax papuensis (Burmeister)		*		
SYNTHEMISTIDAE				
Choristhemis flavoterminata (Martin)		*		
Eusynthemis deniseae Theischinger			*	*
E. nigra (Tillyard)			*	*
CORDULIIDAE				
Austrocordulia refracta Tillyard	*			
Hemicordulia australiae (Rambur)		*		
H. tau Selys		*		
LIBELLULIDAE				
Diplacodes bipunctata (Brauer)		*		
D. haematodes (Burmeister)		*		
Nannophlebia risi Tillyard		*		
Orthetrum caledonicum (Brauer)		*		
O. sabina (Drury)		*		
O. villosovittatum (Brauer)		*		

and montane corridor of eastern Australia. These include *Austroagrion cyane*, the species of *Pseudagrion, Austrolestes leda, Aeshna brevistyla, Hemianax papuensis*, and the species of *Hemicordulia, Diplacodes*, and *Orthetrum*.

The remaining 12 species (*Argiolestes icteromelas*, the chlorolestids, *Diphlebia nymphoides*, the gomphids, *Austroaeschna unicornis, Choristhemis flavoterminata, Eusynthemis nigra, Austrocordulia refracta* and *Nannophlebia risi*) have coastal ranges linked to permanent flowing water; the two new species have similar habitats. The zoogeographic affinities of these 14 stream dwellers are overwhelmingly southern, as are those of other stream frequenting Odonata in eastern Australia (Watson, 1979). Only *Nannophlebia risi* represents a northern group; the chlorolestids, gomphids, *Austroaeschna* and *Austrocordulia* all appear to have southern continental links (Watson, 1979). It is also worth noting that Carnarvon Gorge is the northernmost locality from which *Synlestes tillyardi* and *Diphlebia nymphoides* have been recorded (Watson, unpublished data; W. E. Stewart, personal communication).

Discussion

Although the odonate fauna of Carnarvon Gorge is meagre in comparison with the 116 species of Odonata known from south-eastern Queensland, it must be regarded as an outlier of the south-eastern Queensland fauna, presumably a relict. It is possible, but perhaps unlikely, that the two species known only from the Gorge are endemics; if so, it could imply that isolation has been prolonged. Certainly, the differences between dragonflies collected along the tributaries of the Gorge and individuals of those same species from elsewhere suggest that isolation has been long enough for incipient speciation to have occurred.

The findings at Carnarvon Gorge emphasise the need to study Odonata at other localities that may support outliers of the coastal fauna; the Blackdown Tableland in the Expedition Range, where populations of large *Argiolestes icteromelas* occur, is an obvious choice.

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TWO NEW SPECIES OF *CROITANA* WATERHOUSE (LEPIDOPTERA: HESPERIIDAE) FROM CENTRAL AUSTRALIA

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Abstract

Croitana arenaria sp. n. and *C. aestiva* sp. n. are described from the Alice Springs area, central Australia. Adults and the male and female genitalia are figured, compared with each other and with *C. croites* (Hewitson) from Western Australia.

Introduction

The genus *Croitana* Waterhouse was established in 1932 to contain a single species, *Cyclopides croites* Hewitson. *Croitana croites* was then known to occur in coastal areas of Western Australia from Bunbury to Carnarvon and inland at Pindar. These inland specimens were separated as *Mesodina croites pindar* Waterhouse in an earlier paper in 1932.

A specimen of *Croitana* was first recorded from central Australia by Waterhouse (1937) who mentioned a very worn male from Hermannsburg in the British Museum (Natural History). He tentatively included it in *Croitana croites pindar* and this arrangement was followed by Evans (1949). Six specimens of *Croitana* were taken in central Australia by Mr M. S. Upton in February 1966. Common and Waterhouse (1972) stated that the series collected by Mr Upton probably represented a distinct subspecies and did not recognize subspecies *pindar*. I took a further 34 specimens of a *Croitana* species near Alice Springs in September and October 1978 and when they were compared with those taken by Mr Upton, many differences were immediately noticed. This suggested the presence of two species in central Australia both closely related to *C. croites*, but neither more closely resembled *C. croites* than the other. Further examination has confirmed this view.

Evans (1949) used the term "eyelash" for the tuft of scales between the base of the antenna and the eye and nudum for the unscaled part of the antennal club. Evans' use of these terms is followed here as these structures are otherwise unnamed.

Key to the species of **Croitana** *Waterhouse*

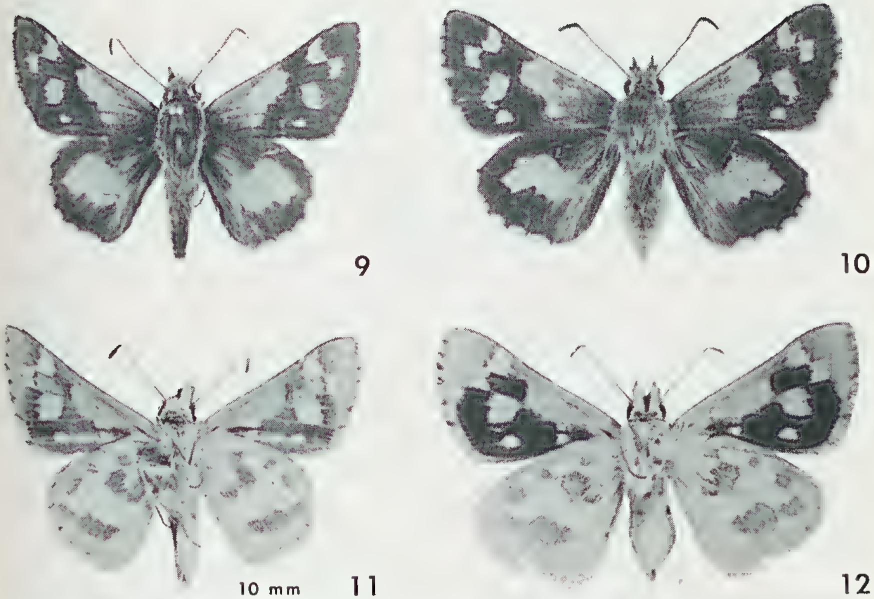
1. Yellow area of hind wing above with veins M_3, CuA_1 and CuA_2 black scaled. Cilia uniformly coloured or faintly chequered . . . . . . *aestiva* sp. n.

– Orange area of hind wing above with veins M_3, CuA_1 and CuA_2 orange scaled. Cilia conspicuously chequered 2

2. Hind wing beneath with dark spot between Rs and M_1 well separated from spot between M_1 and M_2 . . . . *croites* (Hewitson)

– Hind wing beneath with dark spot between Rs and M_1 adjacent to spot between M_1 and M_2 . . . . *arenaria* sp. n.

Figs 1-8. Upper and underside: (1, 3) holotype ♂ *C. arenaria* **sp. n.**; (2, 4) paratype ♀ *C. arenaria* **sp. n.**; (5, 7) holotype ♂ *C. aestiva* **sp. n.**; (6, 8) paratype ♀ *C. aestiva* sp. n.



Figs 9-12. Upper and underside: (9, 11) ♂ *C. croites* (Hewitson) "Bunbury, W.A. Oct. 2, 1961"; (10, 12) ♀ *C. croites* (Hewitson) "Wembly, W.A. Sept. 20, 1961".

Croitana arenaria sp. n.

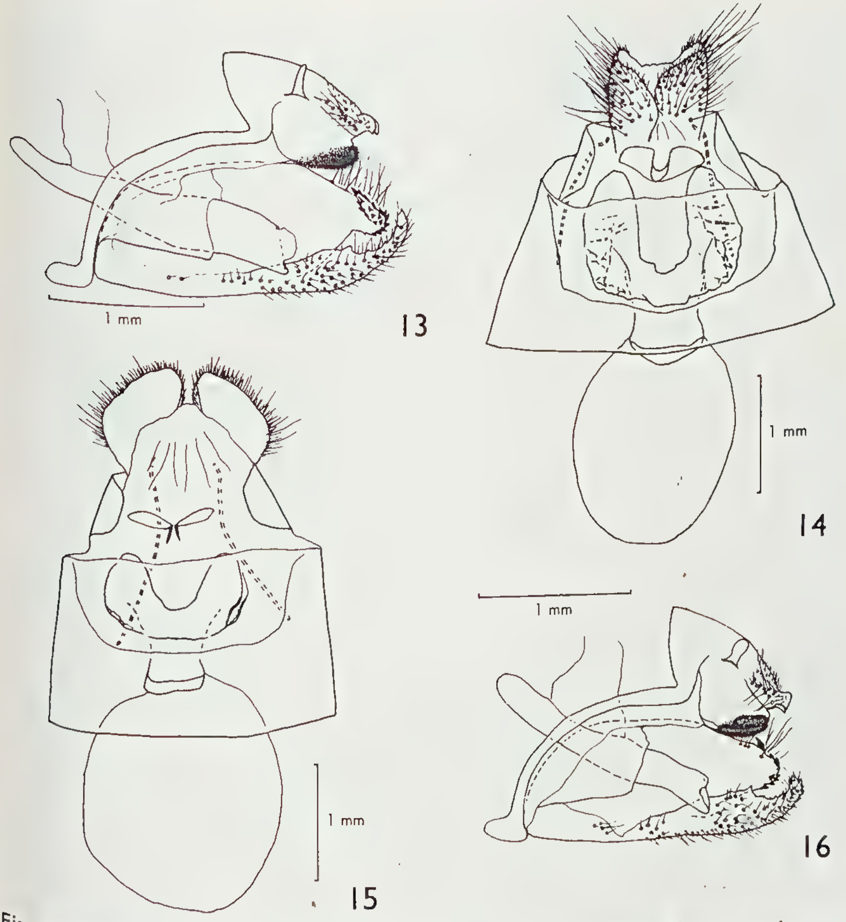
(Figs 1-4, 15, 16)

Types: – *Holotype* ♂ labelled "23.36S 133.35E 32 km WNW of Alice Springs, NT 8 Oct 1978 E. D. Edwards," Reg. No. 3295, in Australian National Insect Collection. 28 ♂♂, 5 ♀♀, *paratypes*: 9 ♂♂, 1 ♀, with same label data as holotype (1 ♂, 1 ♀, genitalia slide M554 and M513 respectively); 13 ♂♂, with same label data as holotype but dated 30 Sept 1978 (1 ♂, genitalia slide M555); 3 ♂♂, 1 ♀, "23.41S 134.15E 39 km E of Alice Springs, NT 25 Sept 1978 E. D. Edwards"; 2 ♀♀, "23:59S 133.56E 32 km S by E of Alice Springs, NT 23 Sept 1978 E. D. Edwards"; 1 ♀, "24.11S 134.01E 56 km S by E of Alice Springs, NT 24 Sept 1978 E. D. Edwards" (genitalia slide M556); 1 ♂, "23.38S 133.53E Todd River 9 km N by E of Alice Springs, NT 10 Oct 1978 E. D. Edwards"; 1 ♂, "22.54S 135.28E Plenty River 187 km ENE of Alice Springs, NT 14 Oct 1978 E. D. Edwards"; 1 ♂, "23.00S 136.08E Plenty River 245 km ENE of Alice Springs, NT 14 Oct 1978 E. D. Edwards"; all in Australian National Insect Collection except for 5 ♂♂ paratypes dated 30 Sept 1978, one in each of the following institutions: Australian Museum, British Museum (Natural History), National Museum of Victoria, Queensland Museum, South Australian Museum. A very worn male in the British Museum (Natural History) labelled "Hermannsberg, central Australia; H. J. Hillier 1911-311" probably belongs to this species but is excluded from the paratypic series.

Distribution: – The species is known from five localities within 60 km of Alice Springs, Northern Territory, and from the Plenty River at Huckitta Homestead (187 km ENE of Alice Springs) and also on the Plenty River at 245 km ENE of Alice Springs. The specimen in the British Museum (Natural History) is from Hermannsburg, 116 km W by S of Alice Springs. The species has been taken in September and October.

Description:– Male (Figs 1, 3). Head black with scattered pale yellow scales; pale yellow scales around eye, "eyelash" black; antennal shaft black ringed with pale yellow, club bent before middle, apiculus blunt, with black and pale yellow rings anteriorly, black towards tip, pale yellow posteriorly, nudum 12 segmented; labial palpus above second segment black with many scattered pale yellow scales, terminal segment black with scattered yellow scales, beneath pale yellow. Thorax: above black with pale yellow hair scales; beneath pale yellow, legs pale yellow, hind tibia without median spurs. Abdomen: above black ringed with pale yellow scales at the rear of most segments, scattered yellow hair scales, tip pale yellow; beneath pale yellow. Fore wing: costa slightly convex at base and slightly concave towards end of cell, apex moderately pointed, termen evenly rounded, dorsum straight; above dark brown, basal one-third with scattered pale yellow scales, three subapical confluent pale yellow spots, one between R_3 and R_4, one between R_4 and R_5 and one between R_5 and M_1, two subterminal confluent pale yellow spots distal to subapicals, one between M_1 and M_2 and one between M_2 and M_3, two confluent pale yellow spots, one between M_3 and CuA_1 with base near origin of M_3, one between CuA_1 and CuA_2 well separated from spots between M_1 and M_3, a pale yellow spot anterior to $1A+2A$ at two-thirds extending half way to CuA_2, large pale yellow spot in cell from one-third to five-sixths length of cell, extending nearly to costa, confluent with a pale yellow spot between base of CuA_1 and CuA_2, a further confluent pale yellow spot between CuA_2 and $1A+2A$, inner margin of these spots ill defined owing to heavy pale yellow scaling, cilia pale yellow, black at tips of veins; beneath dark brown, apex pale yellow surrounded by scattered yellow scales, subapical and subterminal spots distributed and coloured as on upperside, spots between M_3 and CuA_2 orange, end of cell dark brown margined distally by heavy scattering of orange scales, large spot in cell extending to base and end of cell orange, costa pale yellow, small orange spot posterior to origin of CuA_2, cilia pale yellow, black at tips of veins. Hind wing: rounded, tornus very slightly produced; above dark brown with scattered yellow hair scales near base, large orange patch extending from just before end of cell to halfway to termen and from Rs to $1A+2A$, sometimes with smaller orange subbasal spot in cell, cilia pale yellow, black at tips of veins; beneath pale yellow, fine terminal pale yellow-brown line, anal area yellow, two rows of yellow-brown, sometimes yellow-grey, spots, one subterminal other submedian, all spots in each row confluent, both rows running from $Sc+R_1$ to $1A+2A$, subterminal spots between M_1 and M_3 extending to termen, cilia pale yellow, brown at tips of veins. Fore wing length 11-13 mm.

Male genitalia (Fig. 16). Combined tegumen and uncus hood-shaped, much shorter than valva, tip of uncus with two dorsolateral curved projections, lateral lobes from junction of tegumen and uncus long; gnathos with ventral surface covered in fine spinules. Valva with ampulla well developed, tip heavily toothed not curved inwards; harpe narrow, curved dorsally; saccus well developed. Aedeagus long, gradually broadened posteriorly.



Figs 13-16. Male and female genitalia: (13, 14) *C. aestiva* sp. n.; (16, 15) *C. arenaria* sp. n.

Female (Figs 2, 4). Similar to male but with fore wing narrower and termen more rounded, pale yellow spot on fore wing above extending from CuA_2 to 1A + 2A, this spot also visible beneath. Fore wing length 11-14 mm.

Female genitalia (Fig. 15). Two sclerotized lobes of lamella postvaginalis poorly developed; a broad U-shaped sclerotization, slightly folded at edge, on dorsal wall of well developed sinus vaginalis, lamella antevaginalis heavily sclerotized, broadly U-shaped, slightly folded at edge; ductus bursae heavily sclerotized, short; corpus bursae spherical without accessory pouch; abdominal segment 7 of fairly uniform width.

Comments:– In both sexes the size of the spot between CuA_2 and 1A+2A in the fore wing varies greatly and in the female the size of the spot in the cell of the fore wing above also varies greatly. The sizes of the other spots in both sexes are less variable. The orange subbasal spot on the hind wing above varies in size or may be absent. There is little variation in the distribution of the spots on the underside of the hind wing but the colour varies from yellow-brown to yellow-grey.

C. arenaria can be distinguished from *C. croites* (Figs 9-12) by the different wing shape. In *C. arenaria* the termen in both fore and hind wing is more evenly rounded than in *C. croites*. In colour, specimens from the northern end of the range of *C. croites* may approach that of *C. arenaria* and although the spots on the underside of the hind wing tend to become indistinct in *C. croites*, they are always distinct in *C. arenaria*. All spots in the subterminal band on the underside of the hind wing are confluent in *C. arenaria* while in *C. croites* those between Sc + R_1 and Rs and between Rs and M_1 are well separated from the others. The subterminal line of spots ends at 1A + 2A close to the termen in *C. arenaria* while in *C. croites* it ends conspicuously further from the termen. The length of the fore wing of *C. arenaria* varies from 11 - 13 mm in males and 11 - 14 mm in females while that of *C. croites* varies from 12 - 14 mm in males and 13 - 16 mm in females.

C. arenaria was taken in the Macdonnell Ranges, in low hilly areas and in sandplain areas. Females were usually taken feeding at flowers of the family Asteraceae but one was taken flying amongst grasses and another stunned by collision with a vehicle. Males were taken defending territories they had established. In hilly areas territories were in dry creek beds up to 2 m wide where males rested, with wings held vertically, on small stones or on sand. When disturbed by another insect they usually returned immediately but rarely did so when disturbed by a human intruder. Males were very alert and were stalked from a distance of about 10 m from which distance they blended well with their surroundings. In sandplain country they were less easily found although tracks, roads and sandhill crests were searched. However males may establish territories on tracks as several were found on the radiator of a vehicle after it had been following tracks. On the Plenty River males were not found on the broad sandy river bed but on the banks of the river where vehicle tracks and washaways had created bare areas of sand.

Croitana aestiva **sp. n.**

(Figs 5-8, 13, 14)

Types: *Holotype* ♂ labelled "16 miles W of Alice Springs, NT 9 Feb 1966 Britton Upton & McInnes" Reg. No. 3296 in Australian National Insect Collection. 4 ♂♂, 1 ♀, *paratypes*: 3 ♂♂, 1 ♀, with same label data as holotype (1 ♂, 1 ♀, with genitalia slide M123 and M552 respectively); 1 ♂, "Standley Chasm NT 9 Feb 1966 M. S. Upton"; all in Australian National Insect Collection.

Distribution:- The species is known from the area 25 to 41 km west of Alice Springs, Northern Territory, in February.

Description: *Male* (Figs 5, 7). Head black with scattered pale yellow scales, pale yellow scales around eye, "eyelash" black; antennal shaft black ringed with pale yellow, club bent before middle, apiculus blunt, with black and yellow rings anteriorly, black towards tip, pale yellow posteriorly, nudum 13 or 14 segmented; labial palpus, above second segment black with many scattered pale yellow scales, terminal segment black, beneath pale yellow with few scattered black scales. Thorax: above black with pale yellow hair scales; beneath pale yellow, legs pale yellow, hind tibia without median spurs. Abdomen: above dark brown with scattered yellow scales, particularly towards rear of each segment, tip pale yellow with scattered dark brown scales; beneath pale yellow. Fore wing: costa slightly convex at base, slightly concave towards end of cell, apex moderately pointed, termen convex near apex, straighter towards tornus, dorsum straight; above dark brown, basal one third with scattered pale yellow scales three subapical confluent pale yellow spots, one between R_3 and R_4, one between R_4 and R_5 and one between R_5 and M_1, two subterminal confluent pale yellow spots placed distally of subapicals, one between M_1 and M_2 and one between M_2 and M_3, two confluent pale yellow spots, one between M_3 and CuA_1 with base near origin of M_3, one between CuA_1 and CuA_2, well separated from spots between M_1 and M_3, a pale yellow spot anterior to $1A+2A$ at two-thirds extending half way to CuA_2, large yellow spot within cell extending from half to four-fifths length of cell, confluent with a small spot at origin of CuA_1, a further confluent pale yellow spot between cubital vein and $1A+2A$ bisected along fold by black scales, cilia dark brown; beneath dark brown some pale yellow scales towards apex, spots distributed and coloured as on upperside except large spot in cell extending to costa and base and large confluent spot between CuA_2 and $1A + 2A$ absent, cilia yellow-brown sometimes faintly chequered. Hind wing: rounded, tornus slightly produced; above dark brown with scattered yellow hair scales near base, large yellow patch between M_1 and M_3 extending from end of cell half way to termen, adjoined by three yellow spots, one between M_3 and CuA_1, one between CuA_1 and CuA_2 and a small spot between CuA_2 and $1A+2A$, these spots separated by fine lines of dark brown scales, cilia dark brown; beneath pale yellow-brown, darker towards costa, termen and anal area and paler between M_1 and M_3 and CuA_2 and $1A + 2A$, two rows of yellow-brown spots, one subterminal other submedian, subterminal row with spots between $Sc+R_1$ and Rs and M_1 well separated, spots between M_1 and M_2, M_2 and M_3, M_3 and CuA_1, CuA_1 and CuA_2 and spot posterior to CuA_2 all confluent, submedian row with spots between $Sc+R_1$, in cell and between CuA_2 and $1A + 2A$, the first separate but last two confluent, cilia yellow-brown sometimes faintly chequered. Fore wing length 12-13 mm.

Male genitalia (Fig. 13). Combined tegumen and uncus hood-shaped, much shorter than valva, tip of uncus with two dorsolateral curved projections, lateral lobes from junction of tegumen and uncus long and narrow; gnathos with ventral surface covered in fine spinules. Valva with ampulla well developed, tip narrow and curved inwards and anterodorsally, heavily toothed; harpe narrow, curved dorsally; saccus well developed. Aedeagus long, gradually broadened posteriorly.

Female (Figs 6, 8). Similar to male but with wings longer, narrower and termen more rounded and with yellow area in cell on underside of fore wing enclosing a black spot. Fore wing length 14.5 mm.

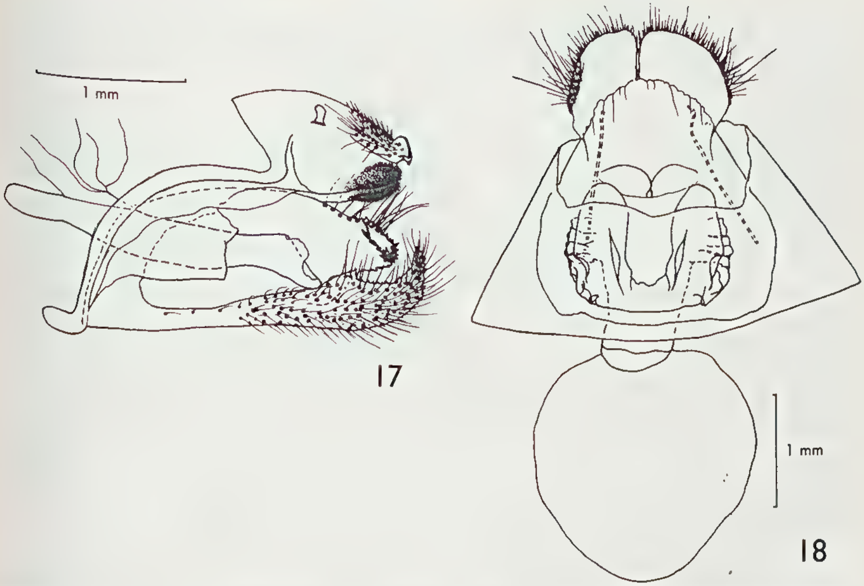
Female genitalia (Fig. 14). Two sclerotized lobes of lamella postvaginalis well developed; a broadly U-shaped sclerotization, folded to produce a crumpled appearance, on dorsal wall of well developed sinus vaginalis; lamella antevaginalis heavily sclerotized, broadly U-shaped, folded to produce crumpled appearance; ductus bursae heavily sclerotized, short; corpus bursae ovoid in section, without accessory pouch; abdominal segment 7 broader anteriorly.

Comments:– In the male the spots between M_1 and M_3 in the fore wing show some variation in size and some specimens show a small spot between CuA_2 and the fold between CuA_2 and 1A+2A.

C. aestiva may be distinguished from *C. arenaria* by the narrower wings. In *C. aestiva* the hind wing yellow area is similar in colour to that of the fore wing cell spot while in *C. arenaria* the fore wing cell spot is pale yellow and the hind wing area is orange. Dark scales along the veins divide the yellow area on the hind wing above in *C. aestiva* but in *C. arenaria* the veins are covered by orange scales within the area. On the underside of the fore wing, in *C. arenaria*, extensive orange scaling produces a conspicuous dark bar at the end of the cell but this is not conspicuous in *C. aestiva.* The underside of the hind wings of the two species differ greatly. All spots in the subterminal band are confluent in *C. arenaria* while in *C. aestiva* those between $Sc + R_1$ and Rs and between Rs and M_1 are well separated from the others. The subterminal spots between M_1 and M_3 are narrower than the adjoining spots in *C. aestiva* but broader and extending to termen in *C. arenaria. C. arenaria* has conspicuously chequered cilia while those of *C. aestiva* are uniformly coloured or faintly chequered. The antennal shaft broadens more gradually into the club in *C. aestiva* than in *C. arenaria* while the nudum segments number 12 in *C. arenaria* and 13 to 14 in *C. aestiva. C. aestiva* has been taken in February and *C. arenaria* in September and October.

In colour *C. aestiva* differs from *C. croites* in the same ways as it differs from *C. arenaria* but the arrangement of the spots on the hind wing beneath is similar in *C. aestiva* and *C. croites. C. aestiva* differs from *C. croites* in wing shape and in the more gradual broadening of the antennal shaft to form the club in *C. aestiva.* The nudum segments number 13 to 14 in *C. aestiva* and 12 to 13 in *C. croites. C. aestiva* has been taken in February while *C. croites* is recorded in July at Pindar and from September to November in other localities.

The male genitalia of the three species of *Croitana* differ slightly. In *C. arenaria* the lateral lobes arising from the junction of the tegumen and uncus are shorter than in *C. aestiva* and longer than in *C. croites* (Fig. 17). Differences in the shape of the two dorsolateral curved projections at the tip of the uncus may also be noted. Most of the ventral surface of the gnathos is covered in spinules in *C. aestiva* and also in *C. arenaria* whereas about half is covered in *C. croites.* The tip of the ampulla is curved inwards in *C. aestiva* and in *C. croites* but not in *C. arenaria.* In *C. aestiva* the tip of the ampulla is more strongly curved inwards and is narrower than in *C. croites.* The tip of the harpe is also narrower in *C. aestiva.* The aedeagus in all three species broadens laterally



Figs 17, 18. Male and female genitalia; *C. croites*, male "Wembley, W.A. Sept. 28, 1961", female "Bunbury, W.A. Oct 7, 1961".

towards the tip but this may not be visible in slide mounted specimens, depending upon coverslip pressure.

The female genitalia of *C. arenaria* have the two sclerotized lobes of the lamella postvaginalis poorly developed but they are more developed in *C. aestiva* and *C. croites* (Fig. 18). The lamella antevaginalis is smaller and less folded in *C. arenaria* than the other species and abdominal segment 7 is uniformly narrow. The corpus bursae in *C. arenaria* and *C. croites* is approximately spherical but in *C. aestiva* it is more elongate.

Discussion

The species described here possess the characters listed by Waterhouse (1932b) in his definition of the genus *Croitana* although his mention of the two dorsolateral projections near the tip of the uncus as "uncus ending in three blunt points" can be misleading. Evans (1949) gave the number of nudum segments as 12 but with the inclusion of the species described here this should now range from 12 to 14. *Croitana* can be immediately distinguished from all other described genera of Trapezitinae, with the exception of *Mesodina* Meyrick, by the absence of the median pair of spurs on the hind tibia. It differs from *Mesodina* however, in the origin of CuA_1 in the fore wing which is only slightly closer to M_3 than to CuA_2 in *Mesodina* but much closer in *Croitana*. Conversely, in the hind wing the origin of CuA_1 is half way between M_3 and CuA_2 in *Croitana* but much closer to M_3 in *Mesodina*. The uncus is very different in the two genera and in *Mesodina* the corpus bursae has an accessory pouch but this is absent in *Croitana*.

There is some doubt about the type locality of *C. croites.* Hewitson labelled the holotype "Austl." and Waterhouse (1932a; 1937) discusses this and concludes that the holotype "no doubt came from near Perth". Evans (1949) gave Carnarvon as the type locality. Colour photographs of the holotype show that it closely resembles some specimens from the Perth area, however too few specimens are available from Carnarvon for an adequate comparison. In any case there is no doubt that the name *C. croites* has been correctly applied to the Western Australian species. An examination of the syntypes of *C. c. pindar* in the Australian Museum shows that they belong to *C. croites.* Some specimens from the northern and inland parts of the range of *C. croites* have markings above paler, the orange patch on the hind wing above smaller, and the underside of the hind wing paler with spots more indistinct, than typical *C. croites.* Such specimens resemble *C. arenaria* above but the spots on the underside of the hind wing retain their positions in *C. croites* and become indistinct, whereas the spots are distinct and in different positions in *C. arenaria.* It is unlikely that *C. arenaria* and *C. aestiva* are seasonal forms of one species. Such forms are unknown in other Trapezitinae and the differences in genitalia, wing shapes, colours and antennae are too great to support such a hypothesis.

C. arenaria and *C. aestiva* are the only Hesperiidae believed to be confined to the arid Eyrean province of Australia. They, and the related *Proeidosa polysema* (Lower), have previously been largely overlooked in the Alice Springs area suggesting that there is much to be learnt of the distribution of the Trapezitinae in the arid areas of Australia. It may be significant that the discovery of *C. arenaria* in some numbers follows several years of relatively good winter rainfall in central Australia. Nothing is known of the early stages of either species.

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I am grateful to Mr A. Atkins for comments and for kindly providing photographs of specimens in the British Museum (Natural History). I thank Mr M. S. Moulds and Mr S. Wallace for lending specimens, Dr C. N. Smithers and Mr G. Daniels of the Australian Museum for allowing access to the collection, Mr A. Allwood of the Northern Territory Department of Industrial Development and Mr L. E. Couchman for information, Dr I. F. B. Common for comments and Mr J. Green for the photographs.

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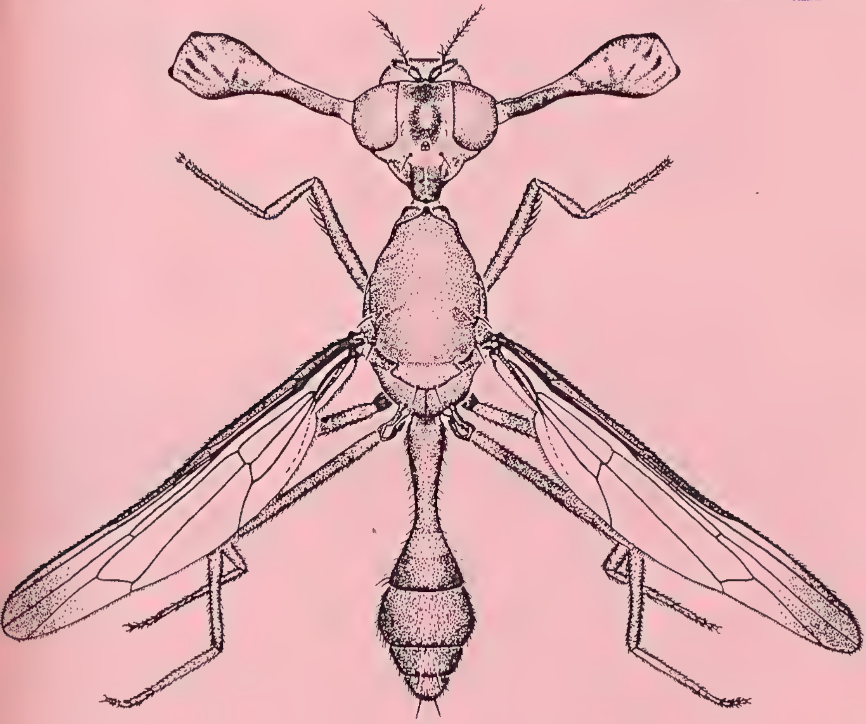

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COVER

Illustrated by Margaret Schneider.

This spectacular fly, *Phytalmia mouldsi* McAlpine and Schneider, is the sole representative of the genus in Australia. It is known only from the rain forests of the Iron Range district of Cape York Peninsula. Other species, some even more spectacular in appearance, occur in New Guinea and neighbouring islands. It is only the males that bear the amazing head projections which they use as contact areas when fighting for territorial and courtship rights.

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THREE NEW SPECIES OF *AMBLYSEIUS* BERLESE FROM NEW CALEDONIA AND AUSTRALIA (ACARI: PHYTOSEIIDAE)

By E. Schicha
Biological and Chemical Research Institute, Department of Agriculture,
Rydalmere, N.S.W., 2116

Abstract

Both sexes of *Amblyseius noumeae* sp. n. and *A. montdorensis* sp. n. from various plants in New Caledonia and *A. markwelli* sp. n. from plants of the family Compositae in Queensland are described and figured.

Introduction

Recent study of mites belonging to the genus *Amblyseius* has revealed three undescribed species. *A. noumeae* sp. n. was very common on many different plants at and around Noumea, New Caledonia, in November and December, 1978. It occurred mostly on the undersides of leaves in association with phytophagous mites. *A. montdorensis* sp. n. was collected at the same time from several plants in a nursery near Noumea, and was preying on eriophyid mites. Specimens of *A. markwelli* sp. n. were obtained from plants of the family Compositae in Queensland in 1976 near strawberry plots which were used for experiments on the integrated control of strawberry mites. This new species was preying on the mite *Tetranychus urticae* (Koch).

Three females and two males of each of the new species from New Caledonia and two females and one male of the new species from Australia were measured, the values being the range in micrometres.

The following abbreviations of depositories are used: SAM South Australian Museum, Adelaide; BCRI Biological and Chemical Research Institute, Rydalmere.

Genus *Amblyseius* Berlese

Amblyseius Berlese, 1914: 143. Type-species by original designation: *Zercon obtusus* Koch, 1839.

Amblyseius noumeae sp. n.

(Figs 1-8)

Types: – NEW CALEDONIA. *Holotype* ♀ (A.nou. 1), on *Acacia simpliciflora* Druce leaves, Noumea, 21.ii.1976, J. Gutierrez (in BCRI). *Paratypes*: 5 ♀♀ (A.nou.2), same data as holotype (in BCRI); 3 ♀♀ (A.nou.3-5), 1 ♂ (A.nou.6), on *Hibiscus* sp. leaves, Noumea, 18.xi.1978, E. Schicha (A.nou.3-4 in SAM, A.nou.5-6 in BCRI); 1 ♀ (A.nou.7), on *Acaci spirorbis* Labill., Noumea, 18.xi.1978, E. Schicha; 1 ♂ (A.nou.8), on *Artocarpus altilis* (Parkinson) Fosberg, Balade, 18.xi.1978, E. Schicha; 1 ♀ (A.nou.9), 1 ♂ (A.nou.10), on *Barringtonia asiaticae* (L.) Kurz, Noumea, 26.xi.1978, E. Schicha; 1♀ (A.nou.11), 1♂ (A.nou. 12), on *Bougainvillea* sp., Noumea, 19.xi.1978, E. Schicha; 1 ♀ (A.nou.13), on *Datura* sp., Mt. Dore, 22.xi.1978, E. Schicha; 1 ♀ (A.nou.14), on *Ficus proteus* Bur., Noumea-Vata, 1.x.1975, J. Gutierrez; 1 ♀ (A.nou.15), on *Phaseolus* sp., Noumea, 4.xii.1978, E. Schicha; 1 ♀ (A.nou.16), 1 ♂ (A.nou.17), on unidentified weed, Noumea, 19.xi.1978, E. Schicha (all in BCRI).

FEMALE

Dorsum. Dorsal shield 349-367 long, 212-218 wide at L4, reticulated laterally, with 17 pairs of setae, six dorsal, two median, four prolateral, five postlateral: D1 25-32 long, D2 and D3 4, D4 to D6 5-6, M1 4-5, M2 and L1 to L3 5-7, L4 8-9, L5 5-7, L6 and L7 7-8, L8 6-7, L9 50-53. L9 slightly serrated, all other setae smooth. All setae shorter than distances between their bases and bases of setae following next in series. Three pairs of large pores and three pairs of small pores as figured. S1 7-9 and S2 5-7 long, on interscutal membrane. Peritremes extending forward near to L1 (Fig. 1).

Venter. Sternal shield 57 long, 76 wide, with three pairs of setae and two pairs of pores as figured, lobate posteriorly. Fourth pair of setae on small metasternal shields (Fig. 2). Vase-shaped ventrianal shield 100-103 long, 78-85 wide, with three pairs of long preanal setae and a pair of preanal pores 28-32 apart (Fig. 3).

Chelicera. Fixed digit 26 long, with three teeth plus pilus dentilis. Movable digit 24 long, with one backwardly pointing tooth (Fig. 4).

Spermatheca. Sack-like cervix 5-7 long atrium occupying three-quarters of width where cervix fuses with macroduct (Fig. 5).

Legs. Six macrosetae: spiniform on genu II 19-21 long, on genu III 27-28, on tibia III 25; spatulate with pointed tip on genu IV 36-39 long, on tibia IV 35-36, on basitarsus IV 50-51 (Fig. 6).

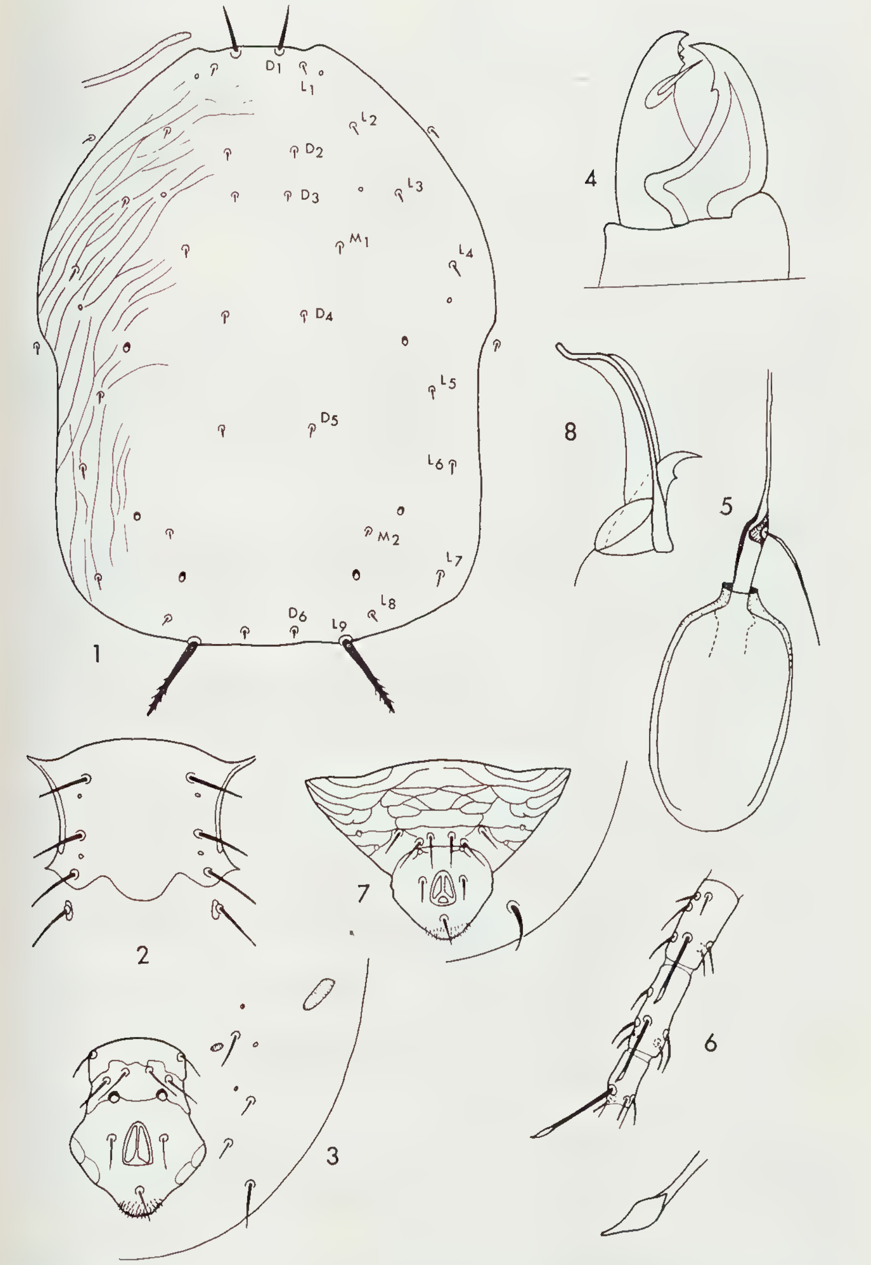
MALE

Dorsum. Dorsal shield 250-255 long, 153-155 wide at L4, with chaetotaxy resembling that of female: D1 25-30 long, D2 to D6, M1, M2 and L1 to L3 4-7, L4 9, L5 to L8 6-8, L9 40-42. S1 and S2 7-10.

Venter. Imbricated ventrianal shield 94-100 long, 146-153 wide, with three pairs of preanal setae and a pair of preanal pores 17-20 apart (Fig. 7).

Spermatodactyl. Shaft including foot 18-20 long; shaft narrow, heel rounded, toe blunt (Fig. 8).

Legs. Six macrosetae similar to those of female: on genu II 14-16 long, on genu III 20-22, on tibia III 19-20, on genu IV 30-33, on tibia IV 31, on basitarsus IV 42-46.



Figs 1-8. *Amblyseius noumeae* **sp. n.** (1-6) female: (1) dorsum, (2) sternal shield, (3) ventrianal shield, (4) chelicera, (5) spermatheca, (6) leg IV; (7, 8) male: (7) ventrianal shield, (8) spermatodactyl.

NOTES

A. noumeae is closely related to *A. ovalis* (Evans) from Malaysia as redescribed by Schicha (1977). However, the female of *A. noumeae* differs from that of *A. ovalis* in (1) the shorter length of all setae on its dorsal shield (D2 to D5, M1 and M2, L1 to L3 and L8 are only half as long and L4 only two fifths as long); (2) the shorter macrosetae of leg IV which are spatulate and pointed apically rather than spiniform and ending with a little knob; and (3) the three (not five) teeth on the fixed digit of the chelicerae.

***Amblyseius montdorensis* sp. n.**

(Figs 9-16)

Types:– NEW CALEDONIA. *Holotype* ♀ (A.mon.1), on *Datura* sp. leaves, Mt. Dore, 22.xi.1978, E. Schicha (in BCRI). *Paratypes*: 2 ♀♀ (A.mon.2-3), 1 ♂ (A.mon.4), same data as holotype (in BCRI); 1 ♀ (A.mon.5), 1 ♂ (A.mon.6), on *Datura* sp., Mt. Dore, 25.xi.1976, J. Gutierrez (♀ in SAM, ♂ in BCRI); 1 ♀ (A.mon.7), on tomato, predacious on eriophyid mites, Mt. Dore, 29.ix.1975, J. Gutierrez (in BCRI); 1 ♀ (A.mon.8), on *Mucuna* sp., Noumea-Vata, 15.v.1975, J. Gutierrez (in BCRI).

FEMALE

Dorsum. Dorsal shield 306-309 long, 140-148 wide at L4, smooth, with 17 pairs of setae, six dorsal, two median, four prolateral, five postlateral: D1 19-23, D2 to D6 and M1 5-9, M2 66-67, L1 43-48, L2 17-21, L3 33-40, L4 66-75, L5 7, L6 35-36, L7 and L8 5-8, L9 82-90. M2 and L9 serrated, all other setae smooth. L2 as long as interspace L2/L3. L1, L3 and L4 longer, all other setae shorter than, distance between their bases and bases of setae following next in series. Five pairs of large pores and three pairs of small pores as figured. S1 24 and S2 8 long, on interscutal membrane. Peritremes extending forward to D1 (Fig. 9).

Venter. Sternal shield 59-60 long, 76-78 wide, with three pairs of setae and two pairs of pores, slightly excavate posteriorly. Fourth pair of setae on metasternal shields (Fig. 10). Pentagonal ventrianal shield 101-102 long, 76-88 wide, with three pairs of preanal setae and a pair of preanal pores 24-29 apart (Fig. 11).

Chelicera. Fixed digit 30-33 long, with nine teeth plus pilus dentilis. Movable digit 31-33 long, with three teeth (Fig. 12).

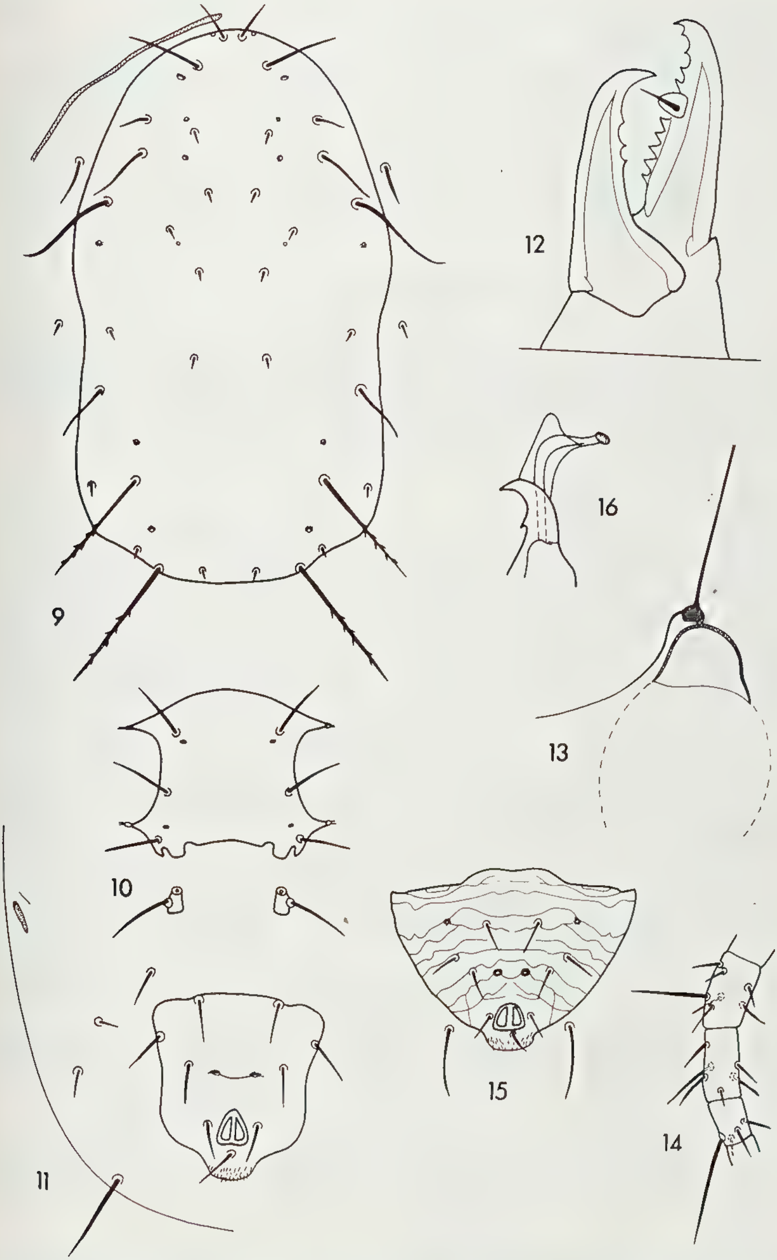
Spermatheca. Cup-shaped cervix 8-9 in diameter, knot-like atrium 3 wide (Fig. 13).

Legs. Five setaceous macrosetae: on genu II 24, on genu III 22, on genu IV 43-46, on tibia IV 33-36, on basitarsus IV 57-64 (Fig. 14).

MALE

Dorsum. Dorsal shield 220-234 long, 114-121 wide at L4, with chaetotaxy resembling that of female: D1 20-21, D2 to D6 and M1 5-8, M2 42-52, L1 32-44, L2 18-19, L3 37-39, L4 65-66, L5 9-10, L6 25-29, L7 and L8 6-9, L9 62-65. S1 21-25 and S2 11.

Venter. Creased ventrianal shield 104-119 long, 156-164 wide, with three pairs of preanal setae and a pair of preanal pores 17 apart (Fig. 15).



Figs 9-16. *Amblyseius montdorensis* **sp. n.** (9-14) female: (9) dorsum, (10) sternal shield, (11) ventrianal shield, (12) chelicera, (13) spermatheca, (14) leg IV; (15, 16) male: (15) ventrianal shield, (16) spermatodactyl.

Spermatodactyl. Shaft 17-18 long. Heel rounded, foot 9-10 long, ending in a small knob (Fig. 16).

Legs. Five setaceous macrosetae: on genu II 16-21, on genu III 18-20, on genu IV 29-33, on tibia IV 28-30, on basitarsus IV 48-54.

NOTES

A. montdorensis is morphologically not obviously related to any species of *Amblyseius.*

Amblyseius markwelli sp. n.

(Figs 17-24)

Types: – QUEENSLAND. *Holotype* ♀ (A.mar.1), on *Crassocephalum crepidiodes* (Benth.) S. Moore, Redland Bay, 16.viii.1976, L. Markwell (in BCRI). *Paratypes:* 5 ♀♀ (A.mar.2-6), 1 ♂ (A.mar.6), same data as holotype; 1 ♀ (A.mar.7), 1 ♂ (A.mar.8), on *Ageratum houstonianum* Mill., Redland Bay, 4.viii.1976, L. Markwell; 1 ♂ (A.mar.9), on *Galinsoga parviflora* Cav., Mt. Gravatt, 4.xii.1975, L. Markwell (all in BCRI).

FEMALE

Dorsum. Dorsal shield 336-342 long, 174-180 wide at L4, reticulated anterolaterally, with 17 pairs of setae, six dorsal, two median, four prolateral, five postlateral: D1 21-23 long, D2 to D4 7-12, D5 12-15, D6 11, M1 8-9, M2 33-36, L1 to L3 11-16, L4 to L8 14-18, L9 75-78, D6, M2 and L9 serrated, all other setae smooth. L8 as long as interspace L8/L9. All other setae shorter than distances between their bases and bases of setae following next in series. Six pairs of large pores and two pairs of small pores as figured. S1 and S2 9-14 on interscutal membrane. Peritremes extending forward to bases of D1 (Fig. 17).

Venter. Sternal shield 57 long, 63-64 wide, with three pairs of setae and two pairs of pores as figured. Fourth pair of setae on metasternal shields (Fig. 18). Pentagonal ventrianal shield 107-114 long, 97-100 wide, with three pairs of short preanal setae and a pair of oval preanal pores 18-23 apart, surrounded by three pairs of setae, six pairs of small shields, primary metapodal shield 27-28 long, secondary metapodal shield 14-17, and one pair of ventrocaudal setae 24-27 (Fig. 19).

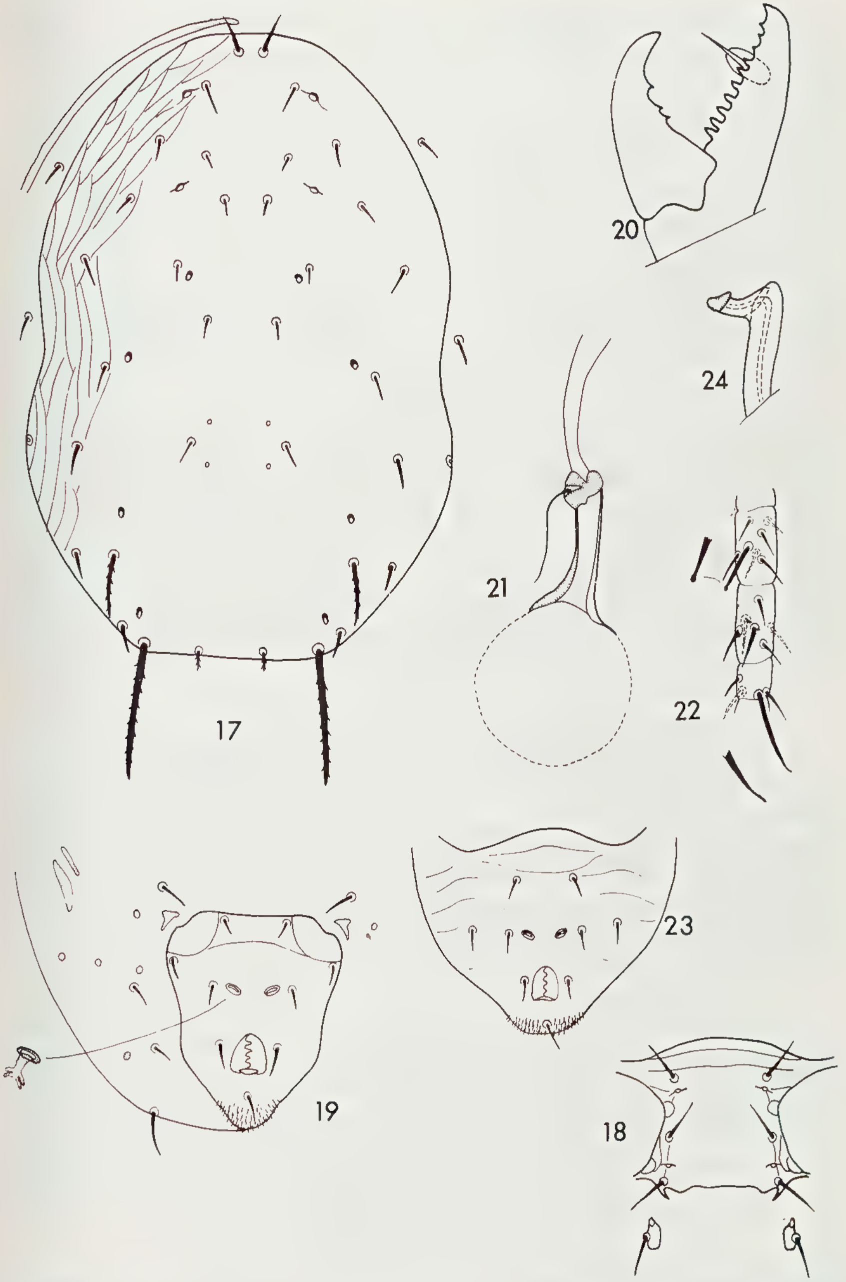
Chelicera. Both digits 26-28 long. Fixed digit with ten teeth plus pilus dentilis; movable digit with three backwardly pointing teeth (Fig. 20).

Spermatheca. Sack-like cervix 14-16 long, 4-5 wide where cervix enters vesicle; atrium occupying whole width of cervix where cervix fuses with major duct (Fig. 21).

Legs. Six macrosetae: blunt on genu II 11-12 long, knobbed on genu III 14-17, setaceous on tibia III 14-17, knobbed on genu IV 24-28, setaceous on tibia IV 18-20 and basitarsus IV 44-48 (Fig. 22).

MALE

Dorsum. Dorsal shield 267 long, 145 wide at L4, with chaetotaxy resembling that of female: D1 19 long, D2 to D6 7-9, M1 8, M2 28, L1 to L3 11-14, L4 17, L5 9, L6 16, L7 and L8 15, L9 60. S1 and S2 7-11 on dorsal shield.



Figs 17-24. *Amblyseius markwelli* **sp. n.** (17-22) female: (17) dorsum, (18) sternal shield, (19) ventrianal shield, (20) chelicera, (21) spermatheca, (22) leg IV; (23, 24) male: (23) ventrianal shield, (24) spermatodactyl.

Venter. Slightly creased ventrianal shield 114 long, 145 wide, with three pairs of short preanal setae and a pair of oval preanal pores 21 apart (Fig. 23). *Spermatodactyl.* Narrow shaft 14 long. Foot 9 long ending in a cone-shaped knob (Fig. 24).

Legs. Six macrosetae similar to those of female: on genu II 10 long, genu III and tibia III 14, on genu IV and tibia IV 21, on basitarsus IV 43.

NOTES

A. markwelli belongs to a group of similar species of which it is most closely related to *A. oguroi* Ehara from Japan, *A. asiaticus* (Evans) from Indonesia (female and male types examined), *A. reptans* Blommers from East Madagascar, and *A. daturae* Gupta from India. However, the female of *A. markwelli* differs: from that of *A. oguroi* in (1) the shorter M2 (one half) and shorter macrosetae of leg IV; and (2) the knobbed, rather than setaceous, macroseta on genu IV; from that of *A. asiaticus* in (1) the longer L5, L7 and L8; (2) the shorter L4, M2 (considerably shorter), and macrosetae on basitarsus IV; and (3) the short, straight and broad, rather than long, coiled and thin cervix; from that of *A. reptans* in (1) the shorter L4, M1 (one half), and M2; (2) the larger ventrianal shield; and (3) the short, straight and broad, rather than long, straight and thin cervix; and from that of *A. daturae* mainly in (1) the shorter M2; (2) the larger ventrianal shield; and (3) the three, rather than four, teeth on the movable digit of the chelicerae.

Acknowledgements

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THE SYSTEMATIC POSITION OF *PAPILIO ANACTUS* MACLEAY (LEPIDOPTERA: PAPILIONIDAE)

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Abstract

The systematic position of *Papilio anactus* Macleay is examined in relation to other species of *Papilio* Linnaeus. It is here placed in the monotypic subgenus *Eleppone* **nov.**, being most closely allied to South American *Heraclides* Hübner and Indo-Papuan *Chilasa* Moore. Larval morphology and foodplant preferences of ancestral Papilionidae are discussed: the ancestral larva is considered to have been smooth and green; ancestral Leptocircini, Troidini and Papilionini are suggested to have fed on Annonaceae, Aristolochiaceae and Rutaceae respectively.

Introduction

The systematic position of *Papilio anactus* has been the subject of uncertainty since its description in 1826. Jordan (1908-10) referred to it as a "mimetic derivation of the *demoleus* group" and associated it with the mimetic *agestor, clytia* (+ *veiovis*), *laglaizei* and *castor* groups. Talbot (1939) placed *anactus* and the *agestor, clytia* (+ *veiovis*) and *laglaizei* groups in the Oriental genus *Chilasa*. Ford (1944) doubted the homogeneity of Talbot's arrangement, suggesting that *anactus* and the *laglaizei* group may have to be removed, and concluded that generic separation was not justified. Munroe (1961) suggested that *anactus* connected the *machaon* group to the *laglaizei* group, yet omitted the species from his taxonomic arrangement. Igarashi (1976) recognized the affinities of *anactus* with the *Chilasa* assemblage, to which he added the South American *anchisiades* group, yet did not regard *anactus* as a member of that assemblage.

A detailed investigation of the species of *Papilio* s.l. (Hancock, 1978) suggests that six subgenera should be recognized. These are: (1) *Pterourus* Scopoli, 1777: a Nearctic and Neotropical subgenus of 25 species placed in five species-groups (*glaucus, troilus, zagreus, scamander* and *homerus*); (2) *Heraclides* Hübner, [1819]: a Nearctic and Neotropical subgenus of 32 species placed in three species-groups (*thoas, torquatus* and *anchisiades*); (3) *Eleppone* **nov.**: a monotypic subgenus containing the Australian *P. anactus*; (4) *Chilasa* Moore, 1881 (=*Clytia* Swainson, 1833 *nec* Lamouroux, 1812 and Robineau-Desvoidy, 1830); an Oriental and Papuan subgenus of 11 species placed in four species-groups (*clytia, veiovis, agestor* and *laglaizei*); (5) *Papilio* Linnaeus, 1758: a Palaearctic and Nearctic subgenus of 14 species placed in the *machaon* group; (6) *Princeps* Hübner, [1807]: a widespread subgenus found in Ethiopian, Oriental, East Palaearctic and Australasian regions, comprising 130 species placed by Munroe (1961) in 26 species-groups.

P. anactus is sufficiently distinct from other species of *Papilio* to warrant subgeneric status under the above arrangement. It is characterized below.

Eleppone[*] subgen. nov.

Type species: *Papilio anactus* W.S. Macleay, 1826. *In* King, *Nar. surv. intertrop. w. coasts Aust.*

Sexes similar; wing pattern mimetic of Troidini; hind wings with both red

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[*] The practice of naming Papilionidae taxa after characters of Greek mythology is followed here. *Elĕpponê* is an anagram of Penelope, wife of Ulysses.

and blue spots present; red pigment type B; anthoxanthins absent. Male genitalia (Fig. 1) with clasper broad, serrate, ventral spine present; juxta not deeply emarginate. Mature larva solitary; dorso-lateral spiny tubercles present in a complete series; blue-black with dorso-lateral and lateral rows of orange-yellow spots. Pupa brown, grey-brown or grey with green markings, roughly textured, slender and relatively straight; paired anterior processes and dorsal thoracic protuberance present. Larval foodplants species of *Eremocitrus, Microcitrus* and *Citrus* (all Rutaceae). Larva and pupa illustrated by Common and Waterhouse (1972) and Igarashi (1976).

Eleppone is separated from the related subgenera *Heraclides* and *Chilasa* by the characters listed in Table 1.

TABLE 1

Characters distinguishing the *Papilio* subgenera *Heraclides, Eleppone* and *Chilasa*

Character	*Heraclides*	*Eleppone*	*Chilasa*
wing pattern	non-mimetic or mimetic of Trodini	mimetic of Troidini	mimetic of Danainae or Uraniidae
red pigment	present, type B	present, type B	absent
fore femora	without orange hairs	with orange hairs	without orange hairs
juxta	deeply emarginate	not deeply emarginate	not deeply emarginate
first abdominal segment of mature larva	with raised band	without raised band	without raised band
abdominal "saddle" of larva	present	absent	absent
larval colour	dark with orange, yellow or white pale patches; occasionally with blue spots	dark with orange-yellow spots	dark with white patches or brown bands; carmine or white spots present (or green with dark pattern)
larval foodplants	Rutaceae or Piperaceae	Rutaceae	Lauraceae
Pupa	stick-like; anterior and dorsal protuberances present	stick-like; anterior and dorsal protuberances present	stick-like or robust; anterior and dorsal protuberances absent

Mimicry of *Papilio anactus*

The mimetic relationship between *P. anactus* and male *Cressida cressida* (Fabricius) (Troidini) seems not to have been generally appreciated. Some authors (e.g. Common and Waterhouse, 1972) have suggested that such a relationship exists between *P. anactus, C. cressida* and *Pachliopta polydorus* (Linnaeus); however it is unlikely that *P. polydorus* is involved, it being only marginally sympatric with the other two species and tending to breed in rainforests rather than woodlands. Other authors (e.g. Ford, 1944) have suggested that *anactus* is a mimic of *Acraea andromacha* (Fabricius) (Acraeinae). Still others (e.g. Igarashi, 1976) regard *anactus* as being non-mimetic.

Apart from a close morphological resemblence between *anactus* and *Cressida*, especially in characters of the hind wing (e.g. 5 large rounded postdiscal red spots; white central area with broadly black discocellular veins), abdomen and thorax (the femoral orange hairs of *anactus* correspond to the lateral prothoracic red streak of *Cressida*), the species are also similar in habitat and behaviour. Both are open forest or woodland species with a normally slow, gliding flight, but with a rapid escape flight (Common and Waterhouse, 1972).

P. anactus has presumably extended its distribution beyond that of *Cressida*, and increased its abundance, by utilizing *Citrus* as a larval foodplant. Much of the mimetic association has been subsequently lost by this extension of range and increased abundance.

Phylogeny

It appears that the ancestral species of *Papilio*, from a centre of origin in eastern North America, dispersed first to the Palaearctic region and subsequently to South America, leaving *Pterourus* in North America. The Palaearctic section appears to have differentiated into a Europe-Asia Minor based subgenus (*Papilio*) and an Oriental (Chinese) based subgenus (*Princeps*), represented primitively by *P. alexanor* Esper and *P. xuthus* Linnaeus respectively. These two subgenera show great similarities in the structure of the male clasper, being typically slender and ventral with a dorsally expanded serrate plate apically. The South American section appears to have dispersed to Australia as *Eleppone* before the late Cretaceous break-up of Gondwanaland, leaving *Heraclides* in South America. Evidence suggests that South-East Asia was also a part of Gondwanaland (Ridd, 1971) and the *Eleppone* ancestor spread to and differentiated there as *Chilasa*. *Heraclides* developed the deeply emarginate juxta characteristic of the subgenus whilst *Chilasa* developed the modified pupa and switched from a rutaceous to a lauraceous larval foodplant. These three "Gondwanaland" subgenera are characterized by a broad male clasper and dark-coloured, tuberculate larvae [secondarily (?) smooth in the *Heraclides thoas* group].

Larvae of *Papilio, Princeps, Heraclides* and *Eleppone* feed primarily on Rutaceae or Umbelliferae, a few species of *Princeps* utilizing Lauraceae. *Pterourus* and *Chilasa* are primarily Lauraceae or Magnoliaceae feeders, some species of *Pterourus* also feeding on Rutaceae.

Ancestral larval morphology and foodplants

Munroe and Ehrlich (1960) concluded that the ancestral papilionid had a red-tuberculate, aristolochiaceous-feeding larva. However, as the Papilionini and Trodini are more closely allied than either is to the more primitive Leptocircini, it appears more likely that the ancestral larva was smooth, green and non-aristolochiaceous-feeding, as in the Papilionini and Leptocircini. The red-tuberculate condition seen in Trodini and Parnassiinae, suggested by Ehrlich and Raven (1965) to have evolved after separation of the Parnassiinae-Papilioninae ancestor from the Baroniinae, may represent a polyphyletic development of aposematic colouration and form in response to the utilization of the toxic Aristolochiaceae. This is supported by the smooth green larva of the primitive *Baronia brevicornis* Salvin (Baroniinae) (Vazquez and Perez, 1961) and the red-tuberculate larvae of some species in the *Protesilaus** *lysithous* group (Leptocircini), the larvae of the latter possibly mimicking *Parides*. One species, the primitive *Protesilaus asius* (Fabricius), has been recorded feeding on both Annonaceae and Aristolochiaceae (Lima, 1968). It is perhaps noteworthy that in *Parnassius*, only two species of which have been recorded feeding on Aristolochiaceae, the tubercles have been lost. The tuberculate larvae of *Heraclides, Eleppone* and *Chilasa*, perhaps also

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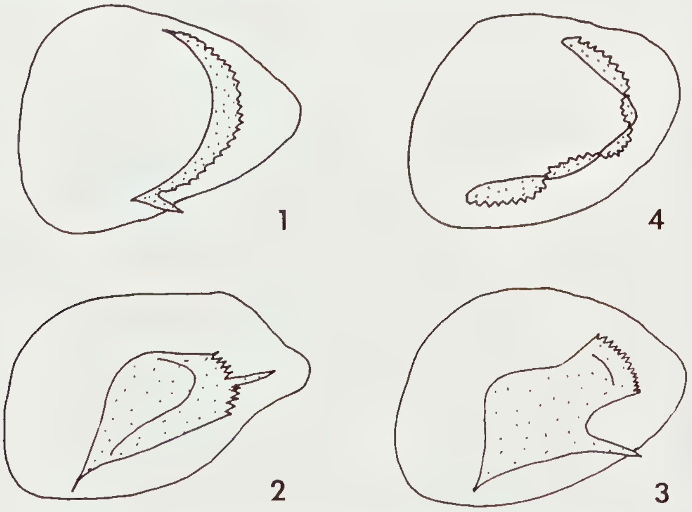
* *Protesilaus* Swainson is here regarded as a genus distinct from *Eurytides* Hübner.

associated with mimicry, lend further support to the suggestion of polyphyletic development of tubercles in the mature larva.

Diversification in the Papilioninae appears to have been facilitated by adaptation to different, but chemically related larval foodplants. A survey of foodplant preferences in the three tribes (*see* Scriber, 1973) shows that Leptocircini feed primarily on Annonaceae, secondarily on Lauraceae and related families, rarely on Aristolochiaeceae; Troidini feed primarily on Aristolochiaeceae, secondarily on Rutaceae; Papilionini feed primarily on Rutaceae, secondarily on Umbelliferae, Lauraceae and related families. Within the tribes foodplant preference relationships are seen between Annonaceae and Lauraceae or Aristolochiaceae, Aristolochiaceae and Rutaceae, Rutaceae and Lauraceae or Umbelliferae. No relationships are seen between Aristolochiaceae and Lauraceae or Annonaceae and Rutaceae [exceptionally *Graphium antiphates* (Cramer) has been recorded on introduced *Citrus* as well as the usual annonaceous foodplants (Marsh, 1960); however this species is closely related to the lauraceous-feeding *G. euphrates* (Felder)].

Thus the Papilioninae ancestor appears to have diverged from an original Annonaceae foodplant to Aristolochiaceae and from there to Rutaceae, resulting in the differentiation of Leptocircini, Troidini and Papilionini respectively. The latter two tribes are most closely related phylogenetically and, as no relationship is known between Aristolochiaceae and Lauraceae foodplant preferences, whereas an Aristolochiaceae-Rutaceae relationship is observable within the Troidini, it appears likely that Rutaceae, and not Lauraceae-Magnoliaceae, represents the ancestral Papilionini foodplant. Hence in both Leptocircini and Papilionini the Lauraceae-Magnoliaceae foodplants are likely to be secondary. Detailed study of the phylogeny of the species supports this conclusion.



Figs 1-4. Right valve and clasper of: (1) *Papilio* (*Eleppone*) *anactus;* (2) *P.* (*Heraclides*) *anchisiades;* (3) *P.* (*H.*) *androgeus;* (4) *P.* (*Chilasa*) agestor.

Summary

On morphological, male genitalic, larval, pupal and larval foodplant characters the monotypic subgenus *Eleppone* nov. represented by *Papilio anactus* Macleay, occupies a systematic position between the subgenera *Heraclides* and *Chilasa*. *Heraclides* resembles *Eleppone* in the nature of the clasper (Figs 2, 3), pupa and larval foodplant; the juxta however is deeply emarginate, U- or V-shaped. *Chilasa* resembles *Eleppone* in the nature of the clasper (Fig. 4), juxta and larva; the pupa however lacks the anterior and dorsal protuberances and the larval foodplants are Lauraceae.

Mimetic species of *Heraclides* resemble *Parides* (Troidini); *Eleppone* mimics male *Cressida* (Troidini); *Chilasa* mimics *Euploea* or *Danaus* (Danainae) or *Alcides* (Uraniidae).

All three tribes of Papilioninae are thus represented in Australia by endemic (or near endemic) monotypic genera or subgenera of Gondwanan origin, viz: Leptocircini by *Protographium* Munroe; Troidini by *Cressida* Swainson; Papilionini by *Papilio* (*Eleppone*). Their South American counterparts are respectively *Eurytides* Hübner, *Euryades* C. & R. Felder and *Papilio* (*Heraclides*). *Protographium* and *Papilio* (*Eleppone*) are represented in South-East Asia by *Graphium* Scopoli + *Lamproptera* G. R. Gray and *Papilio* (*Chilasa*).

Acknowledgements

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BOOK REVIEWS

Guide to Mt Kaindi: background to montane New Guinea ecology by J. L. Gressitt and Nalini Nadkarni. 1978. 8vo. Wau Ecology Institute Handbook No. 5. 135 pp., illustr. Available from the Institute, P.O. Box 77, Wau, P.N.G. Price: K3.00, US$5.00.

As a book presenting a background to New Guinean montane ecology this book is indeed worth buying. It is packed with information about Mt Kaindi, a prominent mountain near the Wau Ecology Institute. For those intending to visit Wau this book is a must.

The greater part of the text is in fact a faunal analysis of the Mountain, giving lists of plants and animals, discussing several and illustrating a number of the interesting plants. There is perhaps a botanical emphasis but insects also gain generous treatment. Included are useful lists of spiders, moths, butterflies, plant-feeding beetles and vegetable insects found on the Mountain.

The introductory chapters provide background data, details of transect analysis procedures used and discussion of the results. A brief statement on conservation appears at the end of the book, a bibliography is provided and an appendix on the nature trails of the Mountain is included.

This book is certainly good value for money and I have no hesitation in recommending it to any biologist intending to visit Papua New Guinea.

M. S. MOULDS

The preparation and curation of insects by Annette K. Walker and Trevor K. Crosby. 1979. 8vo. D.S.I.R. and Entomological Society of New Zealand. D.S.I.R. Inform. Ser. 130. 55 pages, 44 text-figs. ISSN 0077-9636. Price NZ$2.50 (post free by surface mail). Available from: Publications Officer, DSIR, P.O. Box 9741, Wellington, N.Z. *or* Distributions Secretary, Entomological Society of New Zealand, 6 Ocean View Rd. Huia, Auckland *or* N.Z. Government Bookshops.

This handbook explains methods and techniques used for preparing insect specimens for a collection, and how a collection should be curated and managed. Detailed information is given on the following topics: preparation of specimens including relaxing, pinning, card point mounting, double mounting, slide mounting, and labelling; organisation and storage of collections; loans and the dispatching of specimens; restoration of specimens; and basic use of a dissecting microscope. Concluding pages contain a checklist of supplies required with names and addresses of suppliers (mostly N.Z.), and reference and further reading lists.

While the facts presented are mostly basic in nature, much information is contained and I found some useful hints for my own use. Although many of the techniques and equipment discussed are employed internationally, the content in fact centres around those used by the Entomological Division of DSIR in Auckland. One reason for preparing this handbook was to ensure that a uniform and high standard of curation was maintained in the Division's collection when the inevitable staff changes occur.

The book is well written, it is easy to read and understand, and the illustrations, which are important to a book of this type, are more than adequate. I do have some minor criticisms however. There is no index, and although the Contents is detailed, many facts are hard to locate. Perhaps an index could be included in the next edition as I am sure there will be one. I was also surprised to find no reference to a method for restoring greasy Lepidoptera, a common problem in Australia and which also must occur at least occasionally in New Zealand. I find it difficult to support the use of the long and exceptionally thin 00 and 000 size pins recommended in the book for dry mounting insects and I have real doubts about the long term durability of data labels produced photographically.

For both the amateur collector and entomological student this book would be most useful. The professional also could find some useful hints.

M. S. MOULDS

NOTES ON THE BIOLOGY AND DISTRIBUTION OF SOME NORTH QUEENSLAND LYCAENID BUTTERFLIES

By Peter S. Valentine

Department of Geography, James Cook University, Townsville, Queensland, 4811.

Abstract

New distribution records are given for the lycaenid butterflies *Narathura wildei wildei, Ogyris amaryllis, Jamides aleus coelestis* and *Anthene lycaenoides godeffroyi* and new food plants are recorded for *Hypolycaena phorbas* (*Cassia fistula*) and *Hypochrysops apelles* (*Planchonia careya*). Some details of parasites affecting *Jalmenus pseudictinus* are included.

The following observations provide new distribution records for a number of butterflies in the family Lycaenidae and make additional contributions to the biology of some species. The nomenclature follows that of Common and Waterhouse (1972).

***Hypolycaena phorbas* (Fabricius).** A larva collected in March 1977 feeding on *Cassia fistula* in Townsville pupated on 31 March and emerged 9 April 1977. This represents a new food plant record for this butterfly.

***Jalmenus pseudictinus* Kerr and Macqueen.** A large breeding colony of this species occurs 27 km by road from Paluma on a ridge 4 km north of Hidden Valley. This general area is mentioned in Common and Waterhouse (1972). When visited on 18 March 1978 numerous adults were on the wing, seldom flying far from the small shrubs of *Acacia flavescens* upon which the larvae were feeding. There were many larvae and some pupae present on the phyllodes. Many pupae were collected but all had been parasitized by either tachinid flies or ichneumonid wasps. Kerr and Macqueen made similar observations at Millmerran but pupae they found 16 km west of Paluma were not parasitized (Common and Waterhouse, 1972). Larvae were also parasitized. Small braconid wasps which pupate in white cocoons over which the host larvae are invariably draped were common. Larvae which were parasitized by braconid wasps were often identifiable while still active because of obvious colour variations from the normal. During March and April 1978 the period of pupation for both *Jalmenus pseudictinus* and the braconid parasite was six days. The tachinid flies appear to have a similar pupation period as noted in several specimens. Several pupae collected on phyllodes of the food plant were attended by many individuals of the ant *Frogatella kirbyi* but were still parasitized. On 24 April 1978 a female specimen was taken hilltopping 18 km west of Paluma. Another was seen in the area and larvae were noted on nearby *Acacia flavescens* shrubs on a later visit.

***Narathura wildei wildei* (Miskin).** A single male specimen was collected on 11 May 1978 at Garners Beach, just north of Mission Beach, thus extending the southern limit given in Common and Waterhouse (1972) by 25 km.

***Narathura micale* (Boisduval).** Specimens collected on 19 July 1977 at Peach River, north-east of Coen, appear close to *N. m. amphis* (Waterhouse). Monteith and Hancock (1977) consider the possibility of clinal variation in the species although they concluded that Peach River specimens were *N. m. amytis* (Hewitson). The difference between the two subspecies, according to Waterhouse (1942), is in the width of the black band along the termen and in the degree of green above. The fact that the type locality for *N. m. amphis* is Mackay and that for *N. m. amytis* is Cape York, in each case almost the extreme end of the species' total range, supports the notion of clinal variation. A specimen examined from near Cooktown has narrower black margins than specimens from near Townsville. The Peach River specimens are not unlike the Cooktown specimen.

Ogyris amaryllis **Hewitson.** A male was taken and others seen hilltopping on 1 May 1978, 34 km south of Greenvale, about 160 km west of Townsville. The subspecific status of this single specimen cannot be determined although it is likely to be subspecies *meridionalis.*

Hypochrysops apelles **(Fabricius).** This is a fairly common species in the Townsville region and has been found breeding on *Planchonia careya* on many occasions. This is a new food plant record for this butterfly. *P. careya* may well be a food plant replacing *Angophora floribunda* in non-coastal areas of northern Queensland.

Jamides aleus coelestis **(Miskin).** This beautiful butterfly has not previously been recorded south of Tully. Two males were collected in February 1976 in rainforest on the Wallaman Falls road 30 km south-west of Ingham, extending the southern known limit by 90 km.

Anthene seltuttus affinis **(Waterhouse and Turner).** This species is common in Townsville and has been found breeding on *Cassia fistula* where the pupae are usually attached to the stems.

Anthene lycaenoides godeffroyi **(Semper).** Recorded in Common and Waterhouse (1972) as occurring south to Cardwell. One specimen was netted in a Townsville garden in April 1976. More recently I found the species breeding in Townsville on the University campus. The larvae were feeding on both leaves and flowers of *Cassia fistula* and were attended by green ants, *Oecophylla smaragdina*, or by small black ants in a tree where green ants were absent. Pupation of three of these larvae occurred on 25 January 1978 and adults emerged seven days later. All pupae were on the surface of the leaves and were initially bright green in colour, changing to a dark brown colour just prior to emergence. In one tree pupae of both *A. l. godeffroyi* and *A. s. affinis* were present, the two species being easily distinguished as the pupae of the former are stouter. The larvae of the latter were occasionally parasitized by tachinid flies. These records extend the known distribution of *A. l. godeffroyi* southward by 130 km.

Acknowledgements

The assistance of E. C. Dahms of the Queensland Museum in identification and discussion of the parasitic wasp families is gratefully acknowledged. Advice and assistance from M. S. Moulds in the preparation of this paper is also acknowledged.

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THE BUTTERFLIES OF MOUNT KAPUTAR NATIONAL PARK, NEW SOUTH WALES

By G. Daniels
Department of Entomology, University of Queensland, St Lucia, Qld., 4067

Introduction

Mount Kaputar National Park is situated approximately 420 km NNW of Sydney and some 50 km E of Narrabri. The Kaputar plateau is the highest area of the Nandewar Range and forms the major part of the Park. This high and deeply dissected plateau rises abruptly from the north-west plains and represents the eroded remnants of an ancient volcano. Much of the Park has a rich soil derived from the volcanic parent rock and this supports a luxuriant flora. Dry sclerophyll forest covers the bulk of the Park and many of the high tops support large stands of snow gum (*Eucalyptus pauciflora*) and tea tree (*Leptospermum* sp.).

The 37 butterfly species listed here included only one previously recorded from the Park, *Anisynta albovenata weemala* Couchman (Common and Waterhouse, 1972).

Collecting was undertaken during two visits to the Park, each of five days, during January and March 1978. Most attention was given to the areas above 1300 m but three days were spent collecting between 450-1100 m altitude.

Two distinct butterfly faunas appeared to be represented within the Park boundaries, one in the dry sclerophyll areas below 1100 m and another in the snow gum areas above 1400 m. Three species, *Trapezites phigalioides* Waterhouse, *Dispar compacta* (Butler) and *Signeta flammeata* (Butler), were confined to the latter area and were only taken along the sides of gullies bordering creek beds Many of the other species were common only at altitudes below 1100 m although occasional specimens were seen hill-topping on Mount Kaputar (1524 m).

List of species

Species	months recorded
HESPERIIDAE	
Trapezites phigalioides phigalioides Waterhouse	Jan.
Anisynta albovenata weemala Couchman	Sept., Oct.
Dispar compacta (Butler)	Jan.
Signeta flammeata (Butler)	Jan.
Taractrocera papyria papyria (Boisduval)	Mar.
Ocybadistes walkeri sothis Waterhouse	Mar.
PAPILIONIDAE	
Papilio anactus W. S. Macleay	Jan.
Papilio aegeus aegeus Donovan	Mar.
Papilio demoleus sthenelus W. S. Macleay	Mar.
PIERIDAE	
Catopsilia pyranthe crokera (W. S. Macleay)	Mar.
Eurema smilax (Donovan)	Mar.

Delias argenthona argenthona (Fabricius)	Jan.
Delias aganippe (Donovan)	Jan.
Delias harpalyce (Donovan)	Jan.
Delias nigrina (Fabricius)	Jan., Mar.
Anaphaeis java teutonia (Fabricius)	Jan., Mar.
NYMPHALIDAE	
Danaus plexippus plexippus (Linnaeus)	Jan., Mar.
Danaus chrysippus petilia (Stoll)	Jan., Mar.
Euploea core corinna (W. S. Macleay)	Jan., Mar.
Geitoneura acantha acantha (Donovan)	Jan.
Geitoneura klugii klugii (Guérin-Méneville)	Jan.
Heteronympha merope merope (Fabricius)	Jan., Mar.
Polyura pyrrhus sempronius (Fabricius)	Jan., Mar.
Hypolimnas bolina nerina (Fabricius)	Mar.
Vanessa kershawi (McCoy)	Jan., Mar.
Vanessa itea (Fabricius)	Jan., Mar.
Precis villida calybe (Godart)	Jan., Mar.
Acraea andromacha andromacha (Fabricius)	Mar.
LYCAENIDAE	
Jalmenus icilius Hewitson	Mar.
Ogyris genoveva duaringa Bethune-Baker	Mar.
Nacaduba biocellata biocellata (C. & R. Felder)	Jan., Mar.
Theclinesthes miskini (T. P. Lucas)	Jan.
Theclinesthes onycha onycha (Hewitson)	Jan.
Theclinesthes serpentata serpentata (Herrich-Schäffer)	Mar.
Everes lacturnus australis Couchman	Mar.
Zizina otis labradus (Godart)	Jan., Mar.
Candalides xanthospilos (Hübner)	Jan.

Discussion

The distributions of all the above species are extensive and most occur at least throughout eastern Australia. Douglas (1976) recorded 26 species of butterflies from Narrabri, 50 km W of the Park. Of these, eight are unrecorded from the Park and 20 additional species have been found within the Park boundaries.

Eight species, *Trapezites phigalioides, Dispar compacta, Signeta flammeata, Delias nigrina, Geitoneura klugii, Theclinesthes onycha, Everes lacturnus* and *Candalides xanthospilos* have not previously been recorded so far west at this latitude.

During March, eggs, larvae and pupae of *Danaus plexippus* and *D. chrysippus* were common on *Asclepias curassavica* (Fam. Asclepiadaceae) growing along Burrawa Creek. A mature larva of *Papilio demoleus* was found on a citrus tree in the same area. Approximately sixty larvae of *Ogyris genoveva* of varying instars were found under a loose piece of bark on a eucalypt tree. Three of the larger larvae were brought to Sydney but were heavily parasitized by braconid wasps (*Apanteles, ultor* sp. group). The wasp larvae emerged from the base of the ventral prolegs of their host and spun their cocoons almost immediately. The *Ogyris* larvae lived for about four weeks after the emergence of the wasp larvae before dying.

The 37 species recorded from the Park by no means form an exhaustive list of those that can be expected to occur there. Many other species will certainly be found when further, more intensive, collecting is undertaken.

Acknowledgements

Thanks are extended to the National Parks and Wildlife Service for permission to collect within the Park, to the rangers of Mount Kaputar National Park for their assistance and to Mr G. A. Holloway, Australian Museum, for identifying the braconid wasps.

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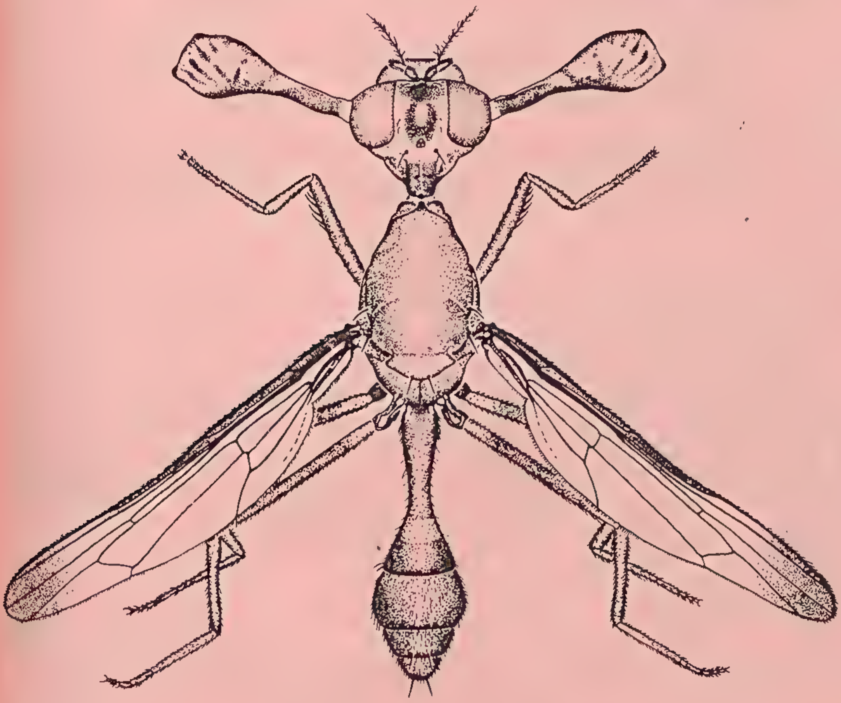

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COVER

Illustrated by Margaret Schneider.

This spectacular fly, *Phytalmia mouldsi* McAlpine and Schneider, is the sole representative of the genus in Australia. It is known only from the rain forests of the Iron Range district of Cape York Peninsula. Other species, some even more spectacular in appearance, occur in New Guinea and neighbouring islands. It is only the males that bear the amazing head projections which they use as contact areas when fighting for territorial and courtship rights.

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THREE NEW SPECIES AND SOME NEW RECORDS OF PSOCOPTERA (INSECTA) FROM TASMANIA

By C. N. Smithers
The Australian Museum, College Street, Sydney.

Abstract

Seven species of Psocoptera are here recorded from Tasmania; three are described as new (*Enderleinella hilla* sp. n., *Blaste panops* sp. n. and *Blaste falcifer* sp. n.), two are new records for Tasmania and two are from previously unrecorded Tasmanian localities.

Introduction

Previous references to the Psocoptera of Tasmania are few, being found mainly in papers by Hickman (1934), Edwards (1950) and New (1971).

Through the courtesy of Mr Lionel Hill I have received a small collection of Psocoptera made as part of a survey of the Lower Gordon River area in south-western Tasmania. The material includes three new species which are described below (*Enderleinella hilli* sp. n., *Blaste panops* sp. n. and *Blaste falcifer* sp. n.), two not previously recorded from Tasmania (*Lepinotus patruelis* Pearman and *Psyllipsocus ramburii* Selys-Longchamps), two already recorded from there (*Lepinotus inquilinus* Heyden and *Heterocaecilius brunellus* (Tillyard)) and a few nymphs which cannot be identified.

Lepinotus patruelis, L. inquilinus and *Psyllipsocus ramburii* are widespread species but *Heterocaecilius brunellus* is so far known from Victoria, New South Wales, New Zealand and now Tasmania. There are no previous records of Psocoptera from south-western Tasmania. The material of the new species is in the Australian Museum (AM), other named material is either in the Australian Museum or the Tasmanian Museum and Art Gallery (TM) and the undetermined nymphal material in the Tasmanian Museum and Art Gallery.

Trogiidae

Lepinotus patruelis Pearman

SOUTH-WESTERN TASMANIA:— 1 ♂, from litter, closed *Melaleuca* forest, transect 14L 250, 42°38′S, 145°54′E, 5.i.1978 (L. Hill *et al.*). 1 ♀, from litter, transect 2R 860, 42°43′S, 145°50′E, 16.ii.1978 (L. Hill *et al.*). 1 ♂, from litter in scrub rainforest, transect 2L 5656, 42°43′S, 145°46′E, 26.i.1977 (L. Hill *et al.*). 1 ♂, wet sclerophyll, moss, transect 12L 700, 42°55′S, 145°52.5′E, 22.ii.1977

(C. Howard *et al.*) (AM), 1 ♂, from wet scrub, litter, transect 2R 1000, 42°43′S, 145°50′E, 8.ii.1977 (C. Howard *et al.*). 1 ♂, from litter, open *Leptospermum* forest, transect 14L 1300, 42°38′S, 145°53′E, 5.i.1978 (L. Hill *et al.*). 1 ♀, scrub rainforest, moss, transect 2L 2900, 42°43′S, 145°47.5′E, 31.i.1977 (L. Hill *et al.*). (TM).

This widespread species has not previously been recorded from Tasmania.

Lepinotus inquilinus Heyden

SOUTH-WESTERN TASMANIA:– 1 ♀, from moss, open *Melaleuca* forest, transect 5R 2050, 42°48′S, 145°53′E, 1.iii.1977 (L. Hill *et al.*) (TM).

Psyllipsocidae

Psyllipsocus ramburii Selys-Longchamps

SOUTH-WESTERN TASMANIA:– 1 ♀, moss, scrub rain forest, transect 2L 4350, 42°43′S, 145°47′E, 18.i.1977 (C. Howard *et al.*) (AM). 2 ♀, moss, scrub rainforest, transect 4-50, 42°41.5′S, 145°52′E, 14.ii.1977 (C. Howard *et al.*). 1 ♀, moss, transect 3R 100, 43°31′S, 145°46′E, 2.ii.1978 (L. Hill). 1 ♀, moss, *E. nitida* woodland, transect 8L 190, 42°37′S, 145°45′E, 9.ii.1978 (C. Howard *et al.*). 1 ♀, litter, scrub rainforest, transect 2L 1140, 42°43′S, 145°48′E, 3.ii.1977 (L. Hill *et al.*). 1 ♀, moss, scrub rainforest, transect 2R 70, 42°43′S, 145°50′E, 8.ii.1977 (C. Howard *et al.*) (TM).

This widespread species has not previously been recorded from Tasmania.

Pseudocaeciliidae

Heterocaecilius brunellus (Tillyard)

SOUTH-WESTERN TASMANIA:– 1 ♀, from scrub forest litter, transect 4-50, 42°41.5′S, 145°52′E, 14.ii.1977 (C. Howard *et al.*) (TM).

Caeciliidae

Enderleinella hilli sp. n.

(Figs 10-12)

FEMALE

Coloration (in alcohol). Head and body very pale creamy white with faint suggestion of a slightly darker area across vertex between eyes. Eyes black. Ocelli colourless. Maxillary palps pale with very pale yellowish brown fourth segment. Scape and pedicel very pale; first two flagellar segments faintly tinged with brown, other segments brown. Legs pale, second tarsal segment pale brown. Wings hyaline with a very faint brownish tinge, a little darker in cell 1A. Abdomen almost colourless.

Morphology. Length of body: 2.7 mm. Median epicranial suture fine. Vertex fairly flat. Postclypeus strongly bulbous. Length of flagellar segments: f_1: 0.70 mm; f_2: 0.58 mm. Eyes moderately large, inner margins diverging slightly behind. IO/D: 0.91; PO: 0.73. Lacinia (Fig. 10). Maxillary palp with very elongate fourth segment. Labrum strongly setose; lateral margins strengthened by a sclerotized bar which is slightly broader proximally than distally; anterior margin sclerotized, more heavily so laterally than nearer the midline; the end of the anterior sclerotized marginal band is backwardly curved at each end in the curvature of which the integument is developed into a small patch with a reticulate pattern. Measurements of hind leg: F: 0.68 mm; T: 1.20 mm; t_1: 0.42 mm; t_2: 0.11 mm; rt: 3.8 : 1; ct: 24, 0. Fore wing length: 4.0 mm; width: 1.3 mm. R_1 gently curving so that pterostigma is relatively long and narrow without distinct apex; R_1 meets wing margin at oblique angle. Stem of radial fork almost straight, R_{2+3} only half as long as radial stem; M arises opposite forking of Rs. Areola postica small and more or less semi-circular. Cu_{1a} and basal section of Cu_{1b} evanescent. Veins, except Cu_2, setose. Epiproct simple, setose, rounded behind, a little longer than base width. Paraproct (Fig. 11) simple, setose; lightly sclerotized except for an elongate, more heavily sclerotized dorso-posterior patch. Trichobothrial field more or less circular. Posterior marginal cones apparently absent. Subgenital plate a simple, setose, lobe. Gonapophyses (Fig. 12) reduced to two small, lightly sclerotized lobes, difficult to see without dissection and staining.

MALE: Unknown.

Material studied. SOUTH-WESTERN TASMANIA: – 1 ♀ (holotype), rainforest beatings, transect 2L 114, 42°43′S, 145°49′E, 3.ii.1978 (L. Hill *et al.*) (AM).

DISCUSSION

Three species are at present included in *Enderleinella* Badonnel, *E. obsoleta* (Stephens) from Europe, *E. zelandica* (Tillyard) from New Zealand and *E. globiclypeus* (Enderlein) from Australia. *E. obsoleta* is easily distinguished by the pointed apophysis at the apex of the lacinia; this is not present in either of the other species nor in *E. hilli*. In *E. globiclypeus*, *E. zelandica* and *E. hilli* the apex is more or less rounded with a slight apical indentation. In both *E. globiclypeus* and *E. zelandica* the ventral valve of the much reduced female gonapophyses is elongate and about four times as long as wide, in *E. hilli* it is much broader and only a little over twice as long as wide. In *E. zelandica* the costal vein in the region of the pterostigma and proximal to it is thickened; in *E. hilli* it is narrow, as usual in the genus. The sclerotized areas on the paraprocts of *E. hilli* are apparently not present in any of the other species. In size, colour and general appearance *E. hilli*, *E. globiclypeus* and *E. zelandica* are similar to one another.

Psocidae

Blaste panops sp. n.

(Figs 1-7)

FEMALE

Coloration (in alcohol). Head pale brown, with darker markings as follows: – a patch occupying the lateral half of each epicranial plate, adjacent to the compound eye; a narrow area across the hind part of the occiput; a circle around each ocellus; a broad band from the eye, through antenna base, down side of postclypeus to anteclypeal suture; two incomplete bars from the broad band between the eye and antenna running towards the ocellar triangle. Genae pale. Labrum dark brown. Scape and pedicel dark brown; first flagellar segment pale brown basally with dark distal quarter; distal segments dark. Eyes black. Maxillary palps pale with dark brown fourth segment. Antedorsum of mesothorax shiny brown; areas adjacent to sutures pale, lateral lobes shiny brown anteriorly and adjacent to scutellum, otherwise pale; legs pale except for dark apices of tibiae and tarsal segments and a dark area at base of femora. Fore wings (Fig. 1) hyaline marked in shades of brown. Veins brown except for Rs and arms of radial fork near Rs, Cu_2, either end of first section of Cu_{1a}, half of second section of Cu_{1a}, distal half of section of M between its leaving Rs and joining Cu_1, which are colourless. Hind wings hyaline with a brown mark between Cu_2 and wing margin. Abdomen pale with irregular, segmentally arranged brown marks.

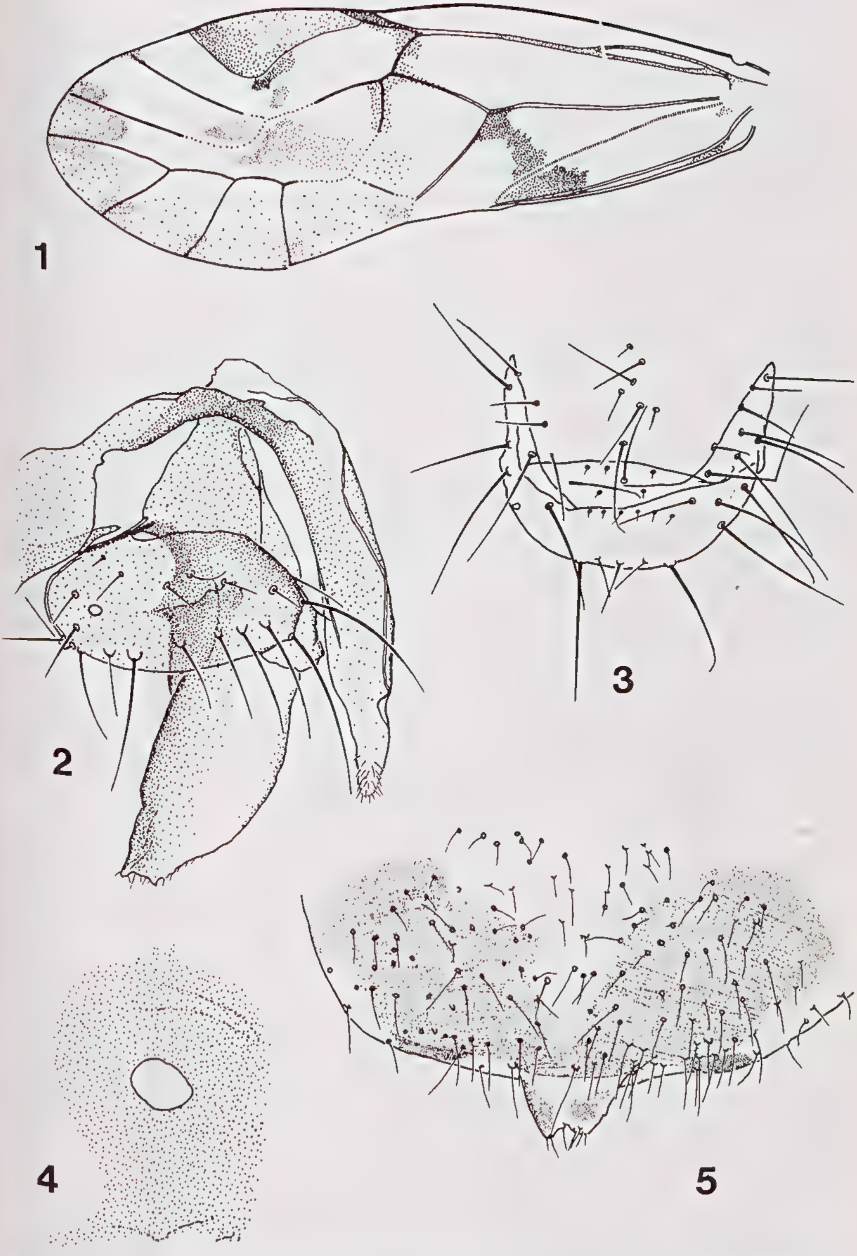
Morphology. Length of body: 3.3 mm. Median epicranial suture distinct, anterior arms evanescent. Vertex rounded, seen from in front slightly concave in middle. Head slightly widened at eye level, with eyes attached at upper angles of head. Lengths of flagellar segments: f_1: 0.96 mm; f_2: 1.00 mm. Antennae with short setae. Eyes large and very prominent, above level of vertex. IO/D: 1.9; PO: 0.92. Ocelli large but not prominent. Measurements of hind leg: F: 0.96 mm; T: 2.04 mm; t_1: 0.64 mm; t_2: 0.16 mm; rt: 4 : 1; ct: 24, 2. Fore wing length: 4.7 mm; width: 1.8 mm. Fore wing (Fig. 1) with Sc meeting R. Stigmapophysis inconspicuous. Rs and M fused for a length. M, slightly curved between Rs and areola postica, to give a posteriorly narrowed discoidal cell. First and second sections of Cu_{1a} almost in a straight line. Veins and margin glabrous. Hind wing with Rs and M fused for a length. Hind wing length: 3.1 mm; width: 1.2 mm. Epiproct (Fig. 3) very lightly sclerotized. Subgenital plate (Fig. 5) with very short posterior lobe, posteriorly emarginate with a few setae on hind margin. Gonapophyses (Fig. 2). Spermathacal entrance (Fig. 4).

MALE

Coloration (in alcohol). As in female.

Morphology. Length of body: 2.6 mm. Head similar to that of female but with somewhat larger and more prominent eyes. Antennae with long setae. IO/D: 1.4; PO: 1.0. Ocelli a little larger than in female. Fore wing length: 4.7 mm; width: 1.8 mm. Fore wing venation as in female (one wing of allotype male with an adventitious vein joining pterostigma to R_{2+3}). Epiproct lightly sclerotized small, sparsely setose, triangular with a large conspicuous almost rectangular dorsal flap (Fig. 7). The flap is slightly upcurved distally and overlies the ninth tergite. It is a little more heavily sclerotized than the epiproct and has a distinctly developed, sclerotized margin which is rugose distally and laterally near the distal end; elsewhere smoother. Paraproct strongly sclerotized in basal three-quarters, less so distally and with short, broad, apical tooth. Hypandrium (Fig. 6) without conspicuous lateral "horns". Phallosome very similar to that of *B. falcifer* (c.f. *B. falcifer,* Fig. 8), narrow, with long, pointed internal parameres and broader, less well sclerotized external parameres which do not project as far posteriorly as the internal parameres; parameres connected basally by thin membrane.

Material examined. SOUTH-WESTERN TASMANIA:— 1 ♀, 1 ♂ (holotype ♀ and allotype ♂), 3 nymphs, heathland, transect 12R 600, 42°55′S, 143°53′E, 15.ii.1978 (L. Hill *et al.*) (AM).



Figs 1-5. *Blaste panops* sp. n. ♀: (1) fore wing; (2) gonapophyses; (3) epiproct; (4) spermathecal entrance; (5) subgenital plate.

DISCUSSION

Blaste panops belongs to a group of five species within the genus in which the eyes are known to be prominent in both sexes in those species for which both are known and placed on slight dorso-lateral extensions of the head capsule; the male phallosome is elongated and remarkable, in *Blaste*, for the extensive fusion of the parameres. The hypandrium bears a pair of postero-lateral, curved "horns" in the other four of the five species of this group. These are *B. tillyardi* Smithers (from New Zealand and New South Wales), *B. furcilla* New and *B. lunulata* New (from Western Australia) and *B. falcifer* Smithers described below from Tasmania. *B. lunulata* has a wing pattern which includes several dark areas in the median cells and areola postica as well as extensive marks elsewhere which are lacking in *B. panops*. *B. panops* can be distinguished from both *B. furcilla* and *B. tillyardi* by the dark areas at the ends of the branches of M and at the end of Cu_{1a}. Also, the mark between R_{4+5} and M_1 at the wing apex is more clearly defined and consists of a paler area surrounded by a darker border. These differences are easily seen in whole specimens; details of differences in genitalia are seen on dissection. There is little difference between *B. panops* and *B. falcifer* in general appearance and their colour patterns are very similar; the males (males only known in *B. falcifer*) differ conspicuously, however, in that the hypandrium of *B. falcifer* carries a pair of well developed, strongly curved, postero-lateral processes which are lacking in *B. panops*. *B. panops* also differs from *B. furcilla* in that the dorsal, anteriorly directed flap attached to the male epiproct tapers in *B. furcilla* but has a transverse distal margin in *B. panops*, as in the other members of this group of species.

The subgenital plates of the three species for which females are known are distinctive. In *B. furcilla* the posterior lobe is apically rounded, in *B. tillyardi* the border is transverse and in *B. panops* the lobe is very short and medially emarginate. (See comment at end of description of female above).

Blaste falcifer sp. n.

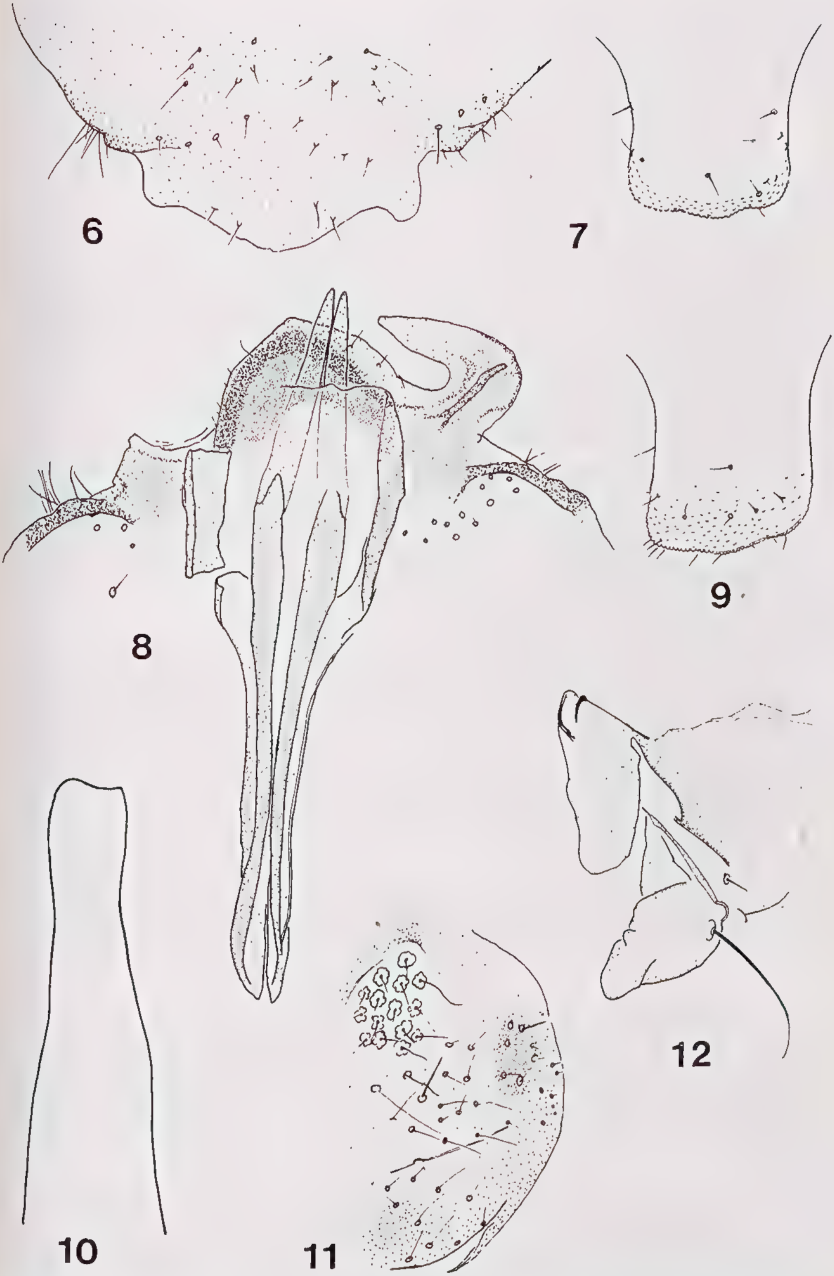
(Figs 8-9)

MALE

Coloration (in alcohol). Identical to that of *Blaste panops* described above, including wing pattern.

Morphology. Length of body: 2.5 mm. Head very similar to that of *B. panops*. Length of flagellar segments: f_1: 1.04 mm; f_2: 1.12 mm. Antennae with long setae, many longer than three times flagellar diameter. IO/D: 1.4; PO: 1.0 (as in *B. panops*). Measurements of hind leg: F: 0.84 mm; T: 1.80 mm; t_1: 0.64 mm; t_2: 0.20 mm; rt: 3.2: 1; ct: 27, 3. Fore wing length: 4.5 mm; width: 1.7 mm. Fore and hind wing venation as in *B. panops*. Hind wing length: 3.5 mm; width: 1.2 mm. Epiproct small, triangular, lightly sclerotized and bearing a dorsal flap (Fig. 9) as in *B. panops* but the flap has a much more lightly sclerotized border which is rugose in distal quarter laterally and across the transverse distal margin; surface rugose over distal quarter; sparsely setose (cf. *B. panops*, Fig. 7). Hypandrium (Fig. 8) with conspicuous, curved postero-lateral apophyses. Phallosome (Fig. 8).

Material examined. SOUTH-WESTERN TASMANIA:– 1♂ (holotype), beating, transect 2R 550, 42°43′S, 145°50′E, 3.ii.1978 (L. Hill *et al.*) (AM).



Figs 6-12. (6-7) *Blaste panops* sp. n. ♂: (6) hypandrium; (7) epiproct. (8-9) *Blaste falcifer* sp. n. ♂: (8) hypandrium and phallosome; (9) epiproct. (10-12) *Enderleinella hilli* sp. n. ♀: (10) lacinia; (11) paraproct; (12) gonapophyses.

DISCUSSION

See under *Blaste panops* above and following key for comparison with related species.

KEY TO AUSTRALIAN SPECIES OF *BLASTE TILLYARDI* GROUP

1. Females (those of *B. lunulata* and *B. falcifer* are not known) 2
— Males 4

2. Fore wing with extensive pigmented area in cell R_5 between forking of Rs and distal half of M before fusion with Cu_{1a}. Ends of median veins marked with a pigment spot. Subgenital plate lobe emarginate, short . . . . *panops* sp. n.
— Fore wings not so marked. Subgenital plate lobe not apically emarginate 3

3. Apex of subgenital plate lobe rounded . . . . *furcilla* New
— Apex of subgenital plate lobe transverse . . . . *tillyardi* Smithers

4. Fore wing with extensive pigmented area in cell R_5 between forking of Rs and distal half of M, before fusion with Cu_{1a}. Ends of median cells with pigment spot or areas of dark pigment at wing base 5
— Fore wings not so marked 7

5. Hypandrium with curved, postero-lateral horns 6
— Hypandrium without curved, postero-lateral horns. (Dorsal flap of epiproct with distal margin transverse) . . . . *panops* sp. n.

6 Fore wings with darkly pigmented areas at wing base and in median cells . . . . *lunulata* New
— Fore wings without darkly pigmented areas at wing base; median cells faintly pigmented . . . . *falcifer* sp. n.

7. Dorsal flap of epiproct with transverse distal margin . . . . *tillyardi* Smithers
— Dorsal flap of epiproct tapering distally . . . . *furcilla* New

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Aust. ent. Mag. 6(4), November, 1979

THREE NEW SPECIES OF ACALYPTRATE FLIES (DIPTERA: LAUXANIIDAE AND PLATYSTOMATIDAE) FROM NORFOLK ISLAND

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Abstract

Two new species of *Poecilohetaerus* Hendel (Lauxaniidae), *P. trivittatus* and *P. ravus*, and one new species of *Pogonortalis* Hendel (Platystomatidae), *P. hians* are described from Norfolk Island with brief mention of distribution and habitat.

Introduction

Though there are numerous undescribed species of Lauxaniidae and Platystomatidae in collections, it is desirable at this stage to provide names for three species in order to draw attention to the interesting endemic elements of the Norfolk Island fauna. As there is a definite need for conservation of the island's flora and fauna as a whole, detailed study of the fauna, and in particular the insect fauna, needs to be done. This is emphasized by the fact that very few specimens of these three species are available for study.

The genus *Poecilohetaerus* occurs in New Zealand, Norfolk Island and Australia (including Lord Howe Island). The New Zealand species, *P. punctatifacies* Tonnoir and Malloch, was dealt with by Harrison (1959) and the Australian species are presently under review by Schneider. The genus *Pogonortalis* occurs in Australia (including Lord Howe Island), Indonesia and Guam (Lower, 1970) and has been introduced into North America.

The three species described in this paper appear to have a somewhat diverse range of habitats, all three being recorded from the settled area of Burnt Pine and two from rain forest areas on Mt. Pitt. The commonly occurring Australian species of the two genera, *Poecilohetaerus schineri* Hendel and *Pogonortalis doclea* Hendel show this same diversity of habitats although other undescribed species of *Poecilohetaerus* are much more restricted in habitat, most being confined to rain forest areas.

In the lists of type material the names of collections are abbreviated as follows: AM, Australian Museum, Sydney; ANIC, Australian National Insect Collection, C.S.I.R.O., Canberra.

Poecilohetaerus trivittatus n. sp.

MALE

Head. Frons dark brown, slightly paler in median region; a white, thickly pruinescent band between eye and fronto-orbital region with white pruinescence extending on to fronto-orbital region. Anterior fronto-orbital bristle distinctly incurved but also slightly reclinate, about three-fourths length of reclinate posterior fronto-orbital; ocellar bristle thinner than and about three-fourths length of anterior fronto-orbital. Parafacial with dense white pruinescence continuous with band on frons; parafacial sutures dark brown; extension of cheek below eye brown with golden pruinescence, much wider

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than lateral extension of mesofacial below it; mesofacial flat, light brown, quite thickly covered with greyish-white pruinescence. Cheek with white, densely pruinescent band below eye, otherwise greyish brown with greyish-white pruinescence. Antenna with segments one and two light brown; segment three about one and one half times as long as wide, dark brown except for ventral basal fulvous region; arista dark brown, with longest pubescence about as long as diameter of base of arista. Prelabrum yellowish brown with greyish white pruinescence; palpus dark brown; proboscis yellowish.

Thorax. Mesoscutum and scutellum mid-brown dorsally with golden pruinescence becoming paler laterally; a broad, longitudinal, well defined white pruinescent vitta immediately lateral to line of dorsocentral bristles, extending from anterior margin of mesoscutum to posterolateral margin of scutellum; a median slightly less dense white pruinescent vitta between the two rows of intradorsocentral setulae, commencing at anterior margin of mesoscutum, discontinued posteriorly. Four strong dorsocentrals, the anterior one placed well in front of suture; only prescutellar acrostichal bristle developed; no anterior intra-alar. Pleura pale yellowish with thin white pruinescence. Legs entirely pale yellowish except for light brown patch on anterior side of distal end of fore femur. Wing, including veins, pale yellowish; veins 3 and 4 only slightly converging apically, the costal section between them 0.86 times length of discal crossvein. Haltere pale yellowish.

Abdomen. Shiny yellowish brown with thin white pruinescence. Postabdomen (Fig. 1) with epandrium (tergite 9) pale, almost unpigmented, narrow dorsally, expanded ventrally, bearing scattered long bristles; surstylus broad at base, divided distally into narrow short, finger-like, mid-brown outer lobe bearing bristles about same length as those on epandrium and pale inner lobe which is longer and broader than outer lobe, tapered to blunt point and slightly upwardly turned apically; hypandrium (sternite 9) narrow, bearing long, narrow, tapered, almost unpigmented, posteroventrally directed gonite; cerci separate, light brown, rounded, bearing numerous quite long bristles; aedeagus broad, largely membranous, rounded and somewhat darkened distally.

Dimensions. Total length 3.8 mm; length of thorax 1.9 mm; length of wing 4.0 mm.

Type. Holotype ♂, Burnt Pine, Norfolk Island, 113 m, 17.vii.1968, M. S. Upton (ANIC).

Poecilohetaerus ravus **n. sp.**

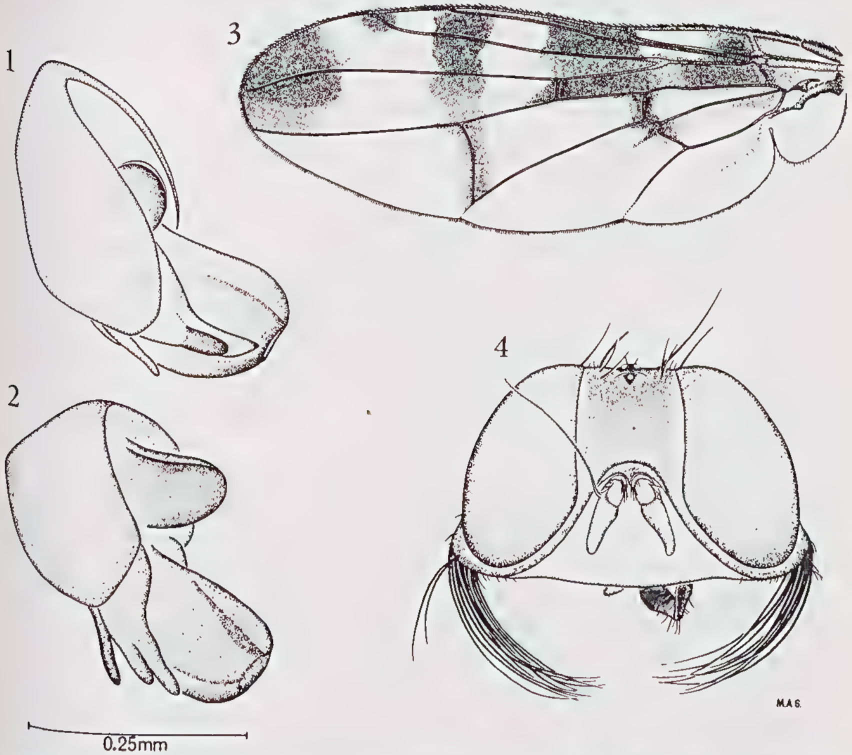
MALE AND FEMALE

Similar to *P. trivittatus* and differing from the description given for that species as indicated below.

Head. Frons pale yellowish anteriorly, medially and around ocellar tubercle, becoming golden brown laterally towards and on fronto-orbital region. Extension of cheek below eye pale yellowish with white pruinescence, not darker, or only very slightly darker yellow than parafacial, not brown as in *P. trivittatus*; cheek otherwise entirely pale yellowish with white pruinescence and without clearly differentiated dense white pruinescence band below eye. Mesofacial translucent, almost unpigmented with white, thin pruinescence; parafacial suture no darker than mesofacial; prelabrum of same colour as mesofacial with white pruinescence.

Thorax with broad, pale yellowish brown longitudinal band in region of dorsocentrals, extending from anterior margin of mesoscutum to posterolateral margin of scutellum; thin white pruinescence over this band but not forming well defined white vitta as in *P. trivittatus*; mesoscutum and scutellum otherwise mid brown dorsally, pale yellowish brown laterally; mesoscutum also with diffuse white pruinescent median vitta, but not confined by line of intradorsocentral setulae laterally as in *P. trivittatus* and extending entire length of mesoscutum; scutellum with whitish pruinescence dorsally. Wing with veins 3 and 4 variably converging apically, the costal section between them from 0.53 to 0.75 times length of discal crossvein.

Abdomen. Tergites dark brown posteriorly (one specimen with tergites more extensively dark brown). Male postabdomen (Fig. 2) similar to *P. trivittatus* but with surstylus not so broad basally, mid to dark brown with inner lobe of similar finger-like shape to outer lobe but slightly more tapered



Figs 1-4. (1, 2) *Poecilohetaerus* spp, male postabdomen, bristles omitted (1) *P. trivittatus*; (2) *P. ravus*. (3, 4) *Pogonortalis hians* (3) left wing; (4) head, anterior view.

apically and about one and one half times as long, much narrower than inner lobe of surstylus of *P. trivittatus*; hypandrial gonite mid brown; aedeagus mid to dark brown, much more sclerotized than in *P. trivittatus.*

Dimensions. Total length ♂ 3.5 mm, ♀ 3.1 - 3.6 mm; length of thorax ♂ 1.6 mm, ♀ 1.4 - 1.6 mm; length of wing ♂ 3.6 mm, ♀ 3.1 - 3.5 mm.

Types. Holotype ♀, Norfolk Island, 17.iv.1972, A. L. Dyce, H. A. Standfast, P. Ferrar (ANIC). *Paratypes*: 1 ♂, 1 ♀, same data as holotype (ANIC); 1 ♀, Burnt Pine, Norfolk Island, 113 m, vii.1968, M. S. Upton (ANIC); 1 ♀, Mt. Pitt, Norfolk Island, 260 m, vii.1968, M. S. Upton (AM).

COMPARATIVE NOTES

P. ravus is closely related to *P. trivittatus* from which it is distinguished by the colour differences on head, thorax and abdomen, more diffuse form of the pruinescent vittae on the mesoscutum, apical convergence of veins 3 and 4 of wing and, in the male, by narrower, finger-like shape of inner lobe of surstylus and sclerotized aedeagus. These two species are quite distinct from any Australian species, being much paler than all except one undescribed species which has a spotted abdomen and dark markings on legs, pleura and face. *P. punctatifacies* (New Zealand) differs markedly in general coloration and in the presence of the two dark brown spots on the mesofacial.

Pogonortalis hians n. sp.

MALE AND FEMALE

Agreeing in most characters with *P. doclea* and with the detailed generic description given by Hendel (1914).

Head (Fig. 4) variable in shape, as in *P. doclea*, but in larger males much more expanded ventrally, with outer margin of cheek expanded beyond outline of eye (as seen from in front), so that fascicle of long curved bristles appears to arise from a lobe; postfrons parallel-sided, tawny, with ocellar and fronto-orbital plates black covered with grey pruinescence; orbital margins of postfrons creamy-pruinescent; face and adjacent membrane between prelabrum and epistomal margin pale buff (these areas brown-pigmented in *P. doclea*). Antenna tawny, with segment 3 becoming greyish brown beyond base. Palpus moderately narrow, brown, becoming tawny apically.

Thorax with predominantly black to brown-black ground colour; posterior notopleural callus, part of humeral callus, and an area behind postalar bristle yellowish brown; mesopleuron becoming yellowish brown posteriorly, and sometimes also anteriorly; pteropleuron with variable yellowish brown zone on upper part; mesoscutum largely covered with ochraceous pruinescence, least noticeable near posterolateral corners; scutellum with thin ochraceous pruinescence from scutellar suture to middle of dorsal surface, not extending to lateral parts, elsewhere shining black; pleura with pale grey pruinescence on much of pteropleuron, a large part of mesopleuron excluding anterior and ventral margins, pleurotergite, and part of hypopleuron. Legs yellowish brown to tawny; femora darker in part; tarsi fulvous, becoming brown distally; fore femur with an outstanding strong black posteroventral bristle at apical third, other ventral bristles weaker and mostly pale; hind femur in both sexes with sharp longitudinal anteroventral ridge distally, which at its broadest point forms an incipient tooth (this ridge represented by little more than a rounded gibbosity in *P. doclea*); hind tibia rather strongly curved. Wing (Fig. 3) with venation very similar to that of *P. doclea* but differently marked; a brown sub-basal patch covering basal two fifths of first basal cell, extending forward into basal part of second costal cell and posteriorly to anterior basal part of anal cell; an irregular brown stigmatal band from basal part of the long, brown stigmatal section of subcostal cell, extending broadly across marginal and submarginal cells, filling distal two fifths of first basal cell, extending narrowly over anterior crossvein into base of first posterior cell, contracted behind vein 4 and narrowly surrounding basal and anal crossveins; a discal band extending from distal end of vein 1 to distal end of vein 5, paler posteriorly; a small brown spot at distal end of vein 2; a large apical brown spot covering distal extremities of submarginal, first posterior, and second posterior cells, much paler in the last; squama reduced to a linear fringe, pale buff. Haltere fulvous.

Abdomen with tergites shining black; hairs partly black, partly pale yellowish; in male tergite 5 about 1.5 - 1.7 times as long as tergite 4.

Dimensions. Total length, ♂ 4.4 - 6.6 mm, ♀ 4.5 - 5.7 mm; length of thorax, ♂ 1.8 - 2.5 mm, ♀ 1.9 - 2.5 mm; length of wing, ♂ 4.0 - 5.7 mm, ♀ 4.5 - 5.9 mm.

Types. Holotype ♀, Mount Pitt, Norfolk Island, 300 m, 17.vii.1968, M. S. Upton (ANIC). *Paratypes*: 1 ♀, Mount Pitt, 260 m, vii.1968, M. S. Upton (ANIC); 1 ♀, Burnt Pine, Norfolk Island, 113 m, vii.1968, M. S. Upton (ANIC); 3 ♂, Norfolk Island, xii.1955, anon. (2 ♂, ANIC; 1 ♂, AM).

COMPARATIVE NOTES

P. hians is closely related to *P. doclea* (Australian mainland) and *P. howei* Paramonov (1957) (Lord Howe Island). It is readily distinguished by the much more extensive wing markings (Fig. 3), black, largely glossy scutellum, and more extensively pruinescent mesopleuron.

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GALLARD 1932: AN OVERLOOKED PAPER ON THE FOOD OF *ITHONE FUSCA* NEWMAN (NEUROPTERA: ITHONIDAE)

By C. N. Smithers
The Australian Museum, 6-8 College Street, Sydney

Tillyard (1922) gave an interesting account of the search for and discovery of the larva of *Ithone fusca* Newman. He described the egg, larva and pupa and gave information on the duration of the stages. His anatomical researches suggested that the larva, like all other known neuropterous larvae, took only liquid food. He decided, by a process of elimination, that the food of larval *Ithone* was scarab larvae and wrote (*loc. cit.* p. 222): "I have not actually succeeded in seeing an *Ithone* larva attack any of its victims, but have no doubt that it is done by an upward stroke, judging by the formation of its mouth-parts"

On the basis of Tillyard's paper it has come to be generally accepted, through repetition in the standard textbooks, that *Ithone* larvae feed on scarab larvae. Careful perusal of Tillyard's paper suggests that, in fact, he based his life history data on field collected larvae and it is not clear whether he succeeded in rearing any individual from egg to adult; the evidence from the paper suggests that he did not. He does, however, mention that scarab larvae confined with *Ithone* larvae were killed, "one having been sucked almost dry, another partly sucked, and the rest having one or more clearly marked wounds which had caused their death". Also "Mr. Gallard had also observed, on more than one occasion, the death and partial sucking-out of scarab larvae to which *Ithone* larvae have been given access" (*loc. cit.* p. 222).

Luke Gallard was closely associated with Tillyard's discovery and work on *Ithone* and later continued it on his own account publishing an important paper (Gallard, 1932) which seems to have been overlooked by subsequent workers. The opening sentence of this paper is significant: "During early work in connection with *Ithone fusca*, the larvae were fed on "white curl grubs" (Scarabaeid larvae), the heads of which had been pinched to prevent them from biting, and on several occasions they were noticed to be sucking freely of their body juices" (*loc. cit.* p. 168). From a comment later in the paper, it is clear that the "early work" referred to is that done with Tillyard although that author does not mention the important fact that the heads of the "prey" had been pinched.

Gallard observed *Ithone* larvae near a large root of *Angophora lanceolata* (fam. Myrtaceae) (Tillyard had also taken "no less than 57 larvae" by digging round a single *Eucalyptus* tree) and from his observations on these and a further "ninety three different groups of *Ithone*" came to the following conclusions: "1.– That but little food is required to develop the larvae of *Ithone* . . . 2.– That their primary food is obtained by suction; water impregnated with solutions from decaying vegetable matter in the soil, or from decaying bark obtained by "chafing" the surface, and extracting the liquids, and probably the body fluids of small Homoptera found in association with decaying bark in the soil. 3.– *Ithone* will not attack or kill "white curl grubs" for food, although they will feed upon the body fluids of "curl grubs" that have been cut or crushed. This food does not agree with them, and shortens their lives"

It is unfortunate that Gallard's work has been overlooked, even within Australia; this note is published with the object of bringing its content to the notice of neuropterists and those responsible for preparing future general texts.

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Aust. ent. Mag. 6(4), November, 1979

DRAGONFLY (ODONATA) RECORDS FROM CENTRAL AUSTRALIA

By G. F. Griffin
19 Cummings Street, Alice Springs, N.T. 5750.

Abstract

Sixteen species are listed from the Northern Territory, south of latitude 21° south. Seven of these, *Austroagrion cyane, Ischnura heterosticta, Austrolestes annulosus, Austrogynacantha heterogena, Orthetrum migratum, Trapezostigma loewi* and *T. stenoloba,* have not been previously recorded specifically from central Australia.

Introduction

The only previously published account of the dragonfly fauna from central Australia is that by Tillyard (1908) who listed 10 species from the Tennant Creek region, approximately 500 km north of Alice Springs. Watson (1974; 1977) lists 18 species as occurring in an area defined as "inland Australia", a region covering approximately one third of the continent, including the southern portion of the Northern Territory.

A series of exceptionally high rainfall years in central Australia from late 1973 to 1977 has given ample opportunity for dragonflies to breed in the region and the opportunity has been taken to survey the dragonfly fauna. Sixteen species are recorded here from the Northern Territory, south of latitude 21° south. Seven of these, *Austroagrion cyane* (Selys), *Ischnura heterosticta* (Burmeister), *Austrolestes annulosus* (Selys), *Austrogynacantha heterogena* (Tillyard), *Orthetrum migratum* Lieftinck, *Trapezostigma loewi* (Brauer) and *T. stenoloba* Watson have not been previously recorded from this region of central Australia although all are known to inhabit inland Australia (cf. Watson 1974; 1977).

The provision of a network of water tanks and dams for pastoral enterprises, mainly over the past 30 years, could also have assisted several species to expand their distributions into formerly lesser watered areas, especially those which breed in still shallow waters. However, the paucity of collectors in central Australia probably accounts for the sparcity of records of most wide-ranging species that periodically inhabit inland Australia.

Records of Odonata taken from 1973 to 1977 by the author are summarised below. These are supplemented by a record of *Orthetrum migratum* held in the Australian National Insect Collection (C.S.I.R.O., Canberra, A.C.T.) to provide a complete checklist. Representative specimens of all species taken by the author have been lodged with the A.N.I.C. while the remaining material is maintained by the author.

In the list following a species is considered "rare" if only one or two individuals have been collected over the entire area; "uncommon" indicates between three and five records and "common" more than five records.

The water types from which dragonflies were collected by the author vary from temporary pools including claypans following heavy rains and isolated creek pools; still, sheltered permanent waters comprising permanent waterholes in gorges or on major waterways (e.g. Finke River), dams or tanks with grassy margins and Alice Springs sewage works; and open permanent waters such as dams or tanks with little or no vegetation on the edges. Collection locations were evenly scattered throughout the region, from Ayers Rock and Andado (Simpson Desert) in the south, to Chilla Well (Tanami Desert) and Ooratiptra in the north. Areas not visited were the Lake Mackay Aboriginal Reserve west of Alice Springs and the far south-eastern part of the Northern Territory.

List of species

COENAGRIONIDAE

Austroagrion cyane (Selys). Rare, apparently restricted to sheltered permanent waterholes in the George Gill Ranges. Collected in November 1975 and December 1976. Watson (1969) recorded specimens closely allied to *A. cyane* from the Amadeus Basin, N.T. These are in fact *A. cyane* (Watson, pers. comm.).

Ischnura aurora aurora (Brauer). Common, October to May but present throughout year; widespread on all water types but prefers still, temporary or permanent pools.

Ischnura heterosticta (Burmeister). Uncommon, collected in February, May and September; restricted to still, sheltered permanent waters.

Xanthagrion erythroneurum Selys. Common, September to May, but in reduced numbers in other months; widespread on all water types especially still pools with grassy banks.

LESTIDAE

Austrolestes annulosus (Selys). Uncommon, August to May, depending on rains to create temporary pools in sheltered areas; also in still permanent waters; widespread.

Austrolestes aridus (Tillyard). Uncommon, collected in November, December, May, March and June; probably seasonally widespread on temporary and permanent, still, sheltered waters.

AESHNIDAE

Hemianax papuensis (Burmeister). Common, December to May, but in reduced numbers throughout the year; widespread on all water types, especially temporary pools but preferring permanent, open water for breeding.

Austrogynacantha heterogena (Tillyard). Rare; 1 ♀ taken, Reedy Rockhole, George Gill Ranges, N.T. 21 November 1975.

CORDULIIDAE

Hemicordulia tau Selys. Common, November to May, but present in reduced numbers in all other months; widespread on all water types.

LIBELLULIDAE

Diplacodes bipunctata (Brauer). Common, August to April, present in reduced numbers in other months; widespread on all water types, especially temporary pools.

Diplacodes haematodes (Burmeister). Common, September to May but rarer in the late summer months, individuals present in winter months; widespread on all water types.

Orthetrum caledonicum (Brauer). Common, September to May but present in reduced numbers in all other months; widespread on all water types.

Orthetrum migratum Lieftinck. In central Australia this species is known only from Standley Chasm, 42 km W of Alice Springs, where it appears to now be well established. In the A.N.I.C. there are 3 ♂, 2 ♀, taken on 9 February 1966 by E. B. Britton, M. S. Upton and R. S. McInnes (J. A. L. Watson, pers. comm.). On 15 April 1979 I collected a further 2 ♂ and several others were seen.

Pantala flavescens (Fabricius). Periodically common, migratory, September to May, widespread on all water types.

Trapezostigma loewi (Brauer). Rare, two records only: 1 ♂, 16 Mile Dam, 30 km N of Alice Springs, N.T., 19 September 1977; 1 ♂, Witchetty Bore, Napperby Station, N.T., 7 January, 1977.

Trapezostigma stenoloba Watson. Moderately common, September to May; widespread on all water types.

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I am grateful to Dr J. A. L. Watson and Mr T. A. Weir of C.S.I.R.O., Division of Entomology, Canberra, A.C.T. for identification of specimens and helpful comments.

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A MIGRATION OF THE CAPER WHITE BUTTERFLY *ANAPHAEIS JAVA TEUTONIA* (FABRICIUS) (LEPIDOPTERA: PIERIDAE)

By H. J. de S. Disney
The Australian Museum, Sydney

Most reports of migrations of the Caper White butterfly, *Anaphaeis java teutonia* (Fabricius), in eastern Australia during November record the species moving in a northerly direction. The record below is therefore of interest.

On the 12th November, 1977, many of these butterflies were seen moving south-west across the Hume Highway from 11 km north of Wangaratta, Victoria, to 29 km south of Yass, N.S.W., a distance of 322 km. The butterflies were observed from 13.00 - 17.00 hrs (Eastern Standard Time) and in the middle part of the day they were crossing the road at the rate of one per minute.

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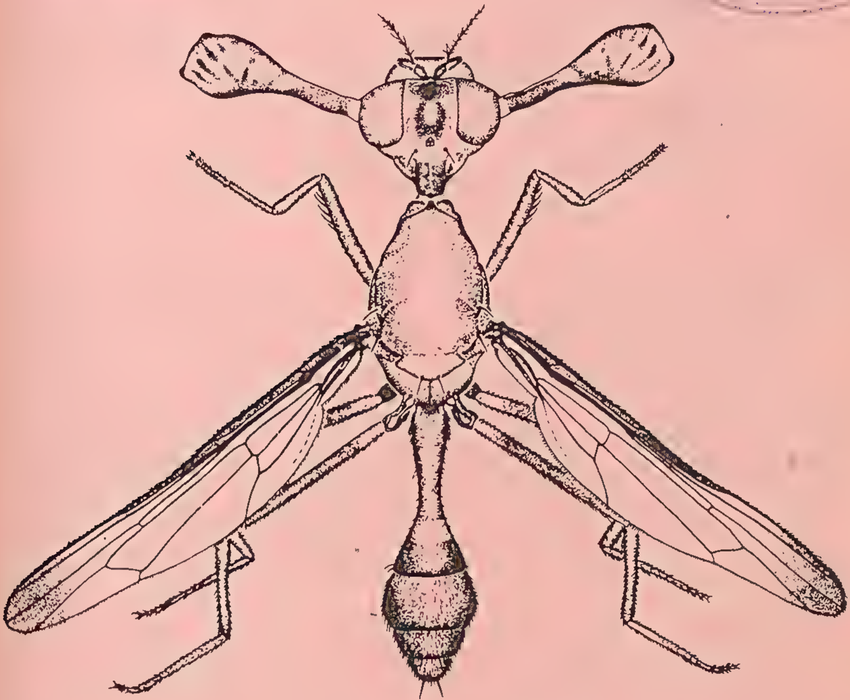

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COVER

Illustrated by Margaret Schneider.

This spectacular fly, *Phytalmia mouldsi* McAlpine and Schneider, is the sole representative of the genus in Australia. It is known only from the rain forests of the Iron Range district of Cape York Peninsula. Other species, some even more spectacular in appearance, occur in New Guinea and neighbouring islands. It is only the males that bear the amazing head projections which they use as contact areas when fighting for territorial and courtship rights.

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THE IDENTITY OF *PHILIRIS NITENS* (GROSE-SMITH) (LEPIDOPTERA: LYCAENIDAE), WITH DESCRIPTION OF A NEW SUBSPECIES FROM PAPUA NEW GUINEA

By D. P. A. Sands

Division of Entomology, Long Pocket Laboratories, CSIRO, Private Bag No. 3,
Indooroopilly, Queensland 4068.

Abstract

The identity of *Philiris nitens* (Grose-Smith) is defined, and both *P. nitens restricta* Tite and *P. kamerungae kamerungae* Waterhouse are considered synonyms of *P. nitens nitens. Philiris nitens lucina* Waterhouse and Lyell is a new combination, and *P. nitens sappheira* ssp. n. is described from Papua New Guinea.

Introduction

The identity of *Philiris nitens* (Grose-Smith) and its status as a species distinct from *P. kamerungae* Waterhouse has been the subject of some doubt (Tite, 1963; Common and Waterhouse, 1972). Tite (1963) examined the male genitalia of the holotype specimen of *P. nitens* and found they were similar to those from specimens identified as *P. kamerungae*; however he considered the wider dark hind wing margin, the absence of a discal white area in the fore wing and the purple tint of the upperside of *P. nitens* males, sufficient to maintain the distinction of the two species. Re-examination of the holotype specimen of *P. nitens* labelled "N. Queensld.", in the British Museum (Natural History), has shown that the colour of the wings falls within the range of variation of specimens identified as *P. kamerungae kamerungae*, thus showing the two species to be conspecific.

Both sexes of *P. nitens restricta* Tite recorded from Cedar Bay, northern Queensland also fall within the range of variation known for ssp. *nitens*, there being specimens known from near Cairns, Kirrama and Tully with no white suffusion on the upperside of the fore wing and wide dark margins on the hind wing. These were characters considered by Tite (1963) to distinguish ssp. *restricta,* which therefore cannot be recognised as a valid subspecies. As a result of the above, *P. kamerungae* and *P. nitens restricta* are synonymised with *P. nitens nitens.*

Philiris nitens nitens (Grose-Smith)
(Figs 1-3)

Holochila nitens Grose-Smith, 1898, p. 107.
Philiris kamerungae Waterhouse, 1903a, pp. 650, 651; 1903b, p. 189. **Syn. n.**
Philiris kamerungae kamerungae Waterhouse, Waterhouse and Lyell, 1914, p. 77; Waterhouse, 1932, p. 137; Tite, 1963, p. 240; Common, 1964, p. 124; D'Abrera, 1971 and 1978, p. 372; McCubbin, 1971, p. 72; Common and Waterhouse, 1972, p. 425.
Philiris nitens (Grose-Smith), Waterhouse, 1903b, p. 190
Candalides kamerungae (Waterhouse), Grunberg in Seitz, 1922, p. 853.
Philiris nitens restricta Tite, 1963, p. 241; Common and Waterhouse, 1972, p. 426. **Syn. n.**
Philiris nitens nitens (Grose-Smith), Tite, 1963, p. 240; Common and Waterhouse, 1972, p. 426.

TYPES:– ***Holochila nitens*** Grose-Smith: *holotype* ♂ labelled, "nitens Grose-Smith Type ♂", "N. Queensld.", "Gen. 1962. 436. G.E.T.", "Rothschild bequest BM. 1939-1" with genitalia slide, in British Museum (Natural History), London. ***Philiris kamerungae*** Waterhouse: *lectotype* ♂, here designated, labelled "Kuranda, N.Q., Mar. 1902, R. E. Turner", "*Philiris kamerungae* type ♂, G. A. Waterhouse, KL21485", in Australian Museum, Sydney. ***Philiris nitens restricta*** Tite: *holotype* ♂ labelled "Cedar Bay, S. of Cooktown (Meek)", "Rothschild bequest BM. 1939-1", "Gen. 1962 440. G.E.T.", "Type HT", "*Philiris nitens restricta* Tite, Holotype ♂, BM type No. Rh 16843" with genitalia slide; *allotype* ♀ labelled "Cedar Bay, S. of Cooktown (Meek)", "Type AT", "*Philiris nitens restricta,* Tite," "ALLOTYPE ♀", BM. Type No. Rh 16844", in British Museum (Natural History), London.

The lectotype of *P. kamerungae* here designated is the specimen referred to by Peters (1971) as the holotype. It bears a red label and is listed in a register of specimens, in the handwriting of G. A. Waterhouse, as the holotype.

Philiris nitens lucina Waterhouse and Lyell, *comb. n.*
(Figs 4-6)

Philiris kamerungae lucina Waterhouse and Lyell, 1914, p. 77; Waterhouse, 1932, p. 138; Tite, 1963, p. 240; Common, 1964, p. 124; D'Abrera, 1971 and 1978, p. 372; McCubbin, 1971, p. 72; Common and Waterhouse, 1972, p. 425.

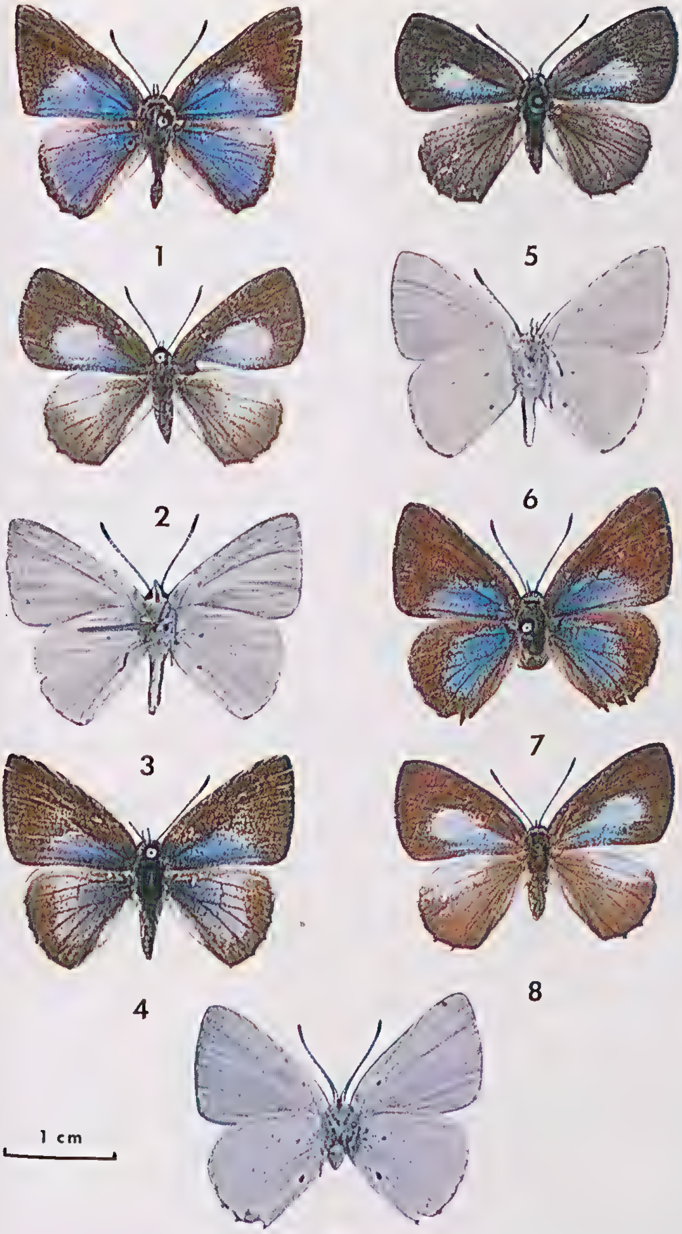
TYPES:– Lectotype ♂ *Philiris kamerungae lucina* Waterhouse and Lyell, here designated, labelled "L5422, Cape York, 18 JLY 1910, H. Elgner", "KL21517", "G. A. Waterhouse collection"; 1 *paralectotype* ♂ labelled "Cape York, H. Elgner", "KL21520"; 3 *paralectotype* ♀♀ labelled "Cape York, 22 Oct 1908, H. Elgner", "KL21518"; "Cape York, Q. 3:3:08, G.A. Waterhouse Coll. Elgner", "KL21519" and "Cape York, 3.8.10, H. Elgner", "KL21521", in Australian Museum, Sydney.

P. nitens lucina Waterhouse and Lyell is recognised to represent specimens from Cape York, Heathlands and Iron Range, northern Queensland.

Philiris nitens sappheira ssp. n.
(Figs 7-10)

Philiris nitens ssp., Sands and Fenner, 1978, p. 107.

TYPES:– Holotype ♂ (ANIC Type Reg. No.3297 genitalia slide M. 511) labelled "PAPUA NEW GUINEA, Rouna Falls, Central Prov., 28 June 1975, 550m, D. P. Sands"; 1 *paratype*



Figs 1-9. *Philiris nitens* sspp.: (1-3) *P. n. nitens* (Grose-Smith), Cairns, northern Queensland; (4-6) *P. n. lucina* Waterhouse and Lyell, Iron Range, northern Queensland; (7-9) *P. n. sappheira* Sands, Rouna Falls, Papua New Guinea. 1, 3, 4, 6, 7, 9 males, 2, 5, 8 females; 1, 2, 4, 5, 7, 8 upperside, 3, 6, 9 underside.

♀ labelled "NEW GUINEA, Subitana (Central District), 1800 ft. Sept. 15, 1949, collected by Wm. Brandt, E. J. L. Hallstrom"; 1 *paratype* ♂ labelled "Kokoda Trl. Cent. Prov. PNG., 10 Jan. 1977, R. Straatman", in Australian National Insect Collection, CSIRO, Canberra; 2 *paratype* ♂♂ labelled "Papua N. Guinea, Central Dist. Rouna, 400 m, T. Fenner" with dates 21 April 1974 and 6 February 1974, in the Central Reference Collection, Department of Primary Industry, Konedobu, Papua New Guinea.

Male (Figs 7, 9). Antennal length (of holotype) 6.8 mm, shaft dull black with white segmental bands, club dull black, apex tipped orange-brown; head grey, frons adjacent to eye margins white, palpus white, terminal segment and dorsal surface dull black, thorax and abdomen dark grey, ventrally white; legs white, tibiae and tarsi with black bands. Fore wing length (of holotype) 13.0 mm, costa almost straight, termen slightly bowed, colour above grey-black, a basal area not reaching discocellular vein, and extending three quarters length of hind margin, bright metallic blue. Hind wing termen rounded, colour above grey-black, basal half bright metallic blue, costa and inner margin greyish. Fore wing beneath, silky white, basal dark suffusion between CuA$_2$ and 1A + 2A. Hind wing colour beneath white, a narrow black terminal line from M$_3$ to tornus, and black submedian spot on inner margin. Cilia white, at veins ends M$_3$, CuA$_1$, CuA$_2$ and tornus, black.

Male genitalia (Fig. 10). Vinculum posteroventrally expanded, sociuncus broad, socii with posterolateral margins bowed; sinus V-shaped, uncus weakly developed, bluntly bifurcate; brachium long, slender, tapered distally; valva slender, subtubular, broad basally, left valva slightly larger than right (viewed posteriorly) with long distal setae; juxta undeveloped, aedeagus simple, postzonal sheath long, prezonal sheath short, weakly developed, cornutal spines absent, replaced by melanic patch within vesica; anal tube long, strongly sclerotized ventrally.

Female (Fig. 8). Antennal length (of paratype) 6.4 mm, antennal shaft, head, palpus, thorax, abdomen and legs similar in colour to male. Fore wing length (of paratype) 13.0 mm, termen bowed; colour above dark grey, with central white spot, overlaid with pale blue scales posterior to cell, not reaching base, and extending slightly more than half inner margin. Hind wing rounded, colour above grey-brown, costa with white area not reaching base, extending to M$_2$; cilia white, at vein ends M$_3$, CuA$_1$, CuA$_2$ and tornus dark brown. Fore and hind wing beneath, similar to male.

Comments

Waterhouse and Lyell (1914) described *P. kamerungae lucina* (now considered to be *P. nitens lucina*) from specimens collected at Cape York, northern Queensland. Male specimens since collected at the Claudie River, Heathlands and Lockerbie Scrub, northern Queensland can be distinguished from the southern ssp. *nitens* by the broader dark margins and less extensive blue on the upperside of both wings. In the males of *P. nitens nitens* the white area of the costa of the hind wing rarely extends posteriorly to vein M$_1$, whereas in ssp. *lucina* a postmedian white suffusion is usually present from the

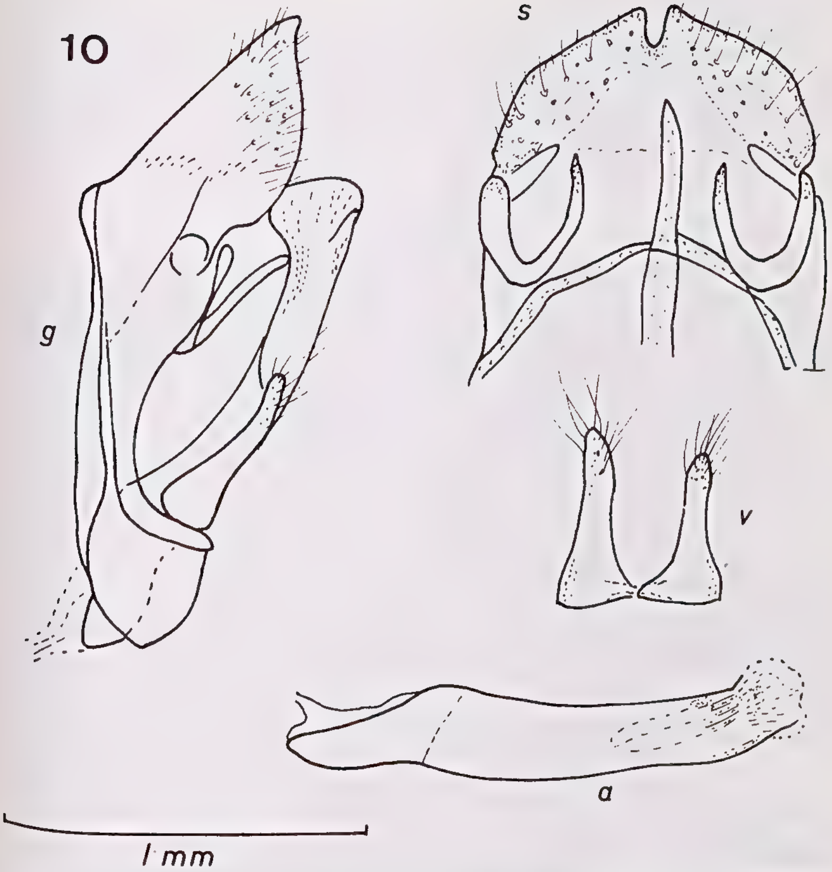


Fig. 10. *Philiris nitens sappheira* Sands, holotype male genitalia: a, aedeagus; g, lateral view, genitalia unmounted; s, sociuncus; v, valvae from slide preparation.

costa to CuA_1. Another difference recorded by Sands and Fenner (1978), is the shorter valvae of the male genitalia of ssp. *lucina*.

Female specimens of both *P. nitens nitens* and *P. nitens lucina* are similar and extremely variable. Such variation was noted elsewhere in the genus by Forbes (1977). One female of *P. nitens nitens* collected in Cairns and reared in Brisbane has the upperside of both pairs of wings extensively white, with only narrow black margins. Other females are known (including the allotype of *P. nitens restricta*) with the hind wing almost entirely dark brown and only a faint grey suffusion on the postmedian portion of the costa. The fore wing area of white may also be reduced to a slight suffusion overlaid by blue scales.

Male specimens of *P. nitens sappheira* may be distinguished from the Australian subspecies by the restricted areas of blue and absence of white from both wings above, and the rounded termen of both wings. The valvae of the male genitalia of *P. nitens sappheira* are shorter than those of *P. nitens nitens* but are similar in length to *P. nitens lucina* (Sands and Fenner, 1978). Females of *P. nitens sappheira* are very similar to some females of Australian material and cannot be distinguished from them.

Acknowledgements

I am grateful to Professor J. F. R. Kerr and Mr M. De Baar for access to their private collections, to Mr R. I. Vane-Wright, and Dr I. F. B. Common for allowing examination of specimens in the British Museum (Natural History), London and the Australian National Insect Collection, CSIRO, Canberra respectively. The study formed part of a post graduate programme carried out at the Department of Entomology, University of Queensland.

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Aust. ent. Mag. 6(5), April, 1980

THE BIOLOGY OF *RHINONCUS AUSTRALIS* OKE (COLEOPTERA: CURCULIONIDAE), A WEEVIL ATTACKING THE WEED *EMEX AUSTRALIS* STEINHEIL IN EASTERN AUSTRALIA

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Abstract

The introduced weed *Emex australis* is attacked by the native weevil *Rhinoncus australis*. Adult *R. australis* fed on all plant parts except roots, mature fruits and male flowers. Most eggs (83%) were deposited in pits in stems, petioles and developing fruit. The larvae tunnelled actively in stems, petioles and the pericarp of young fruit. Pupation occurred in chambers inside stems.

Adult males lived as many as 245 days, females 191 days, and as many as 579 eggs were laid. The average time between generations, i.e. the time from emergence of one adult to the emergence of its progeny is 45 days (range 38-53).

Under insectary conditions *R. australis* retarded growth and seed production of *E. australis*. Field populations of *R. australis* increased in spring and early summer but were never large enough to affect growth or seed production of the weed.

Introduction

The weevil, *Rhinoncus australis* Oke, 1931, is a native of Australia. We have observed it feeding on four species of Polygonaceae including the weed *Emex australis* Steinheil at Two Wells and Port Pirie, South Australia; Ootha (near Parkes), New South Wales; Ma Ma Creek and Queensland Agricultural College (near Gatton), Queensland; *E. spinosa* Campdera at Merbein, Victoria; *Rumex brownii* Campdera and *R. crispus* L. at Brisbane, Queensland. It has also been collected from *Polygonum persicaria* L. in New Zealand (E. C. Zimmerman, pers. comm., 1978).

Our interest in this insect developed during 1974 and 1975 during field evaluation of the weevil *Perapion antiquum* (Gyllenhal) which had been introduced for biological control of *E. australis* (Harley and Kassulke, 1975; Julien and Harley, 1978). Of organisms found attacking *E. australis*, the only one causing consistent damage and having a mode of attack similar to that of *P. antiquum* was *R. australis*.

Methods and materials

An insectary colony of *R. australis* was established using adults collected from Ma Ma Creek, Queensland, in December 1976, and *E. australis* as the food plant. Progeny of this colony were used in these studies.

Mature adults were confined on *E. australis* plants for 24 hours and then removed. Plants were held in the insectary and at intervals were sampled to determine larval and pupal development rates and to obtain immature stages for measurement. Newly emerged adults were placed on *E. australis* for observations of feeding, copulation and oviposition. The insectary temperature was 27°C ± 2°C.

Pupae were removed from the *E. australis* stems and placed on moist filter paper. After emergence the adults were sexed and pairs were then separated and held on *E. australis.* Oviposition was monitored and the number of eggs and their location on the plant recorded. The longevity of unfed adults and adults allowed to feed on *E. australis* for 8 days and then starved was also recorded. These observations were carried out under laboratory conditions where the daily temperature was 25° ± 5°C.

Field observations were made at Two Wells, South Australia and Ma Ma Creek, Queensland, between 1975 and 1977.

Biology

Adults. Adults of *R. australis* (Fig. 1) are *ca* 2.5 mm long and vary in colour from tan to dark brown or charcoal. Areas of whitish body setae give a mottled appearance. Many specimens have a small patch of white scales on the anterior section of the adjoining edges of the elytra. Newly developed adults are cream to beige but darken and harden during the first 24 hours. Emergence occurs through holes, 1.5 - 2.5 mm diameter, cut in the stem wall of *E. australis* generally near the base of stems. *R. australis* is a jumping weevil and has not been observed flying.

In adult females, the posterior edge of ventrite 5 is straight whereas the posterior edge in the male is shallowly "V"-shaped (Figs 2, 3). There is an emargination in the male pygidium on the mid-line and adjacent to the 5th ventrite (Fig. 3). Ventrite 1 is slightly concave along the mid-line in the male and flat or slightly convex in the female.

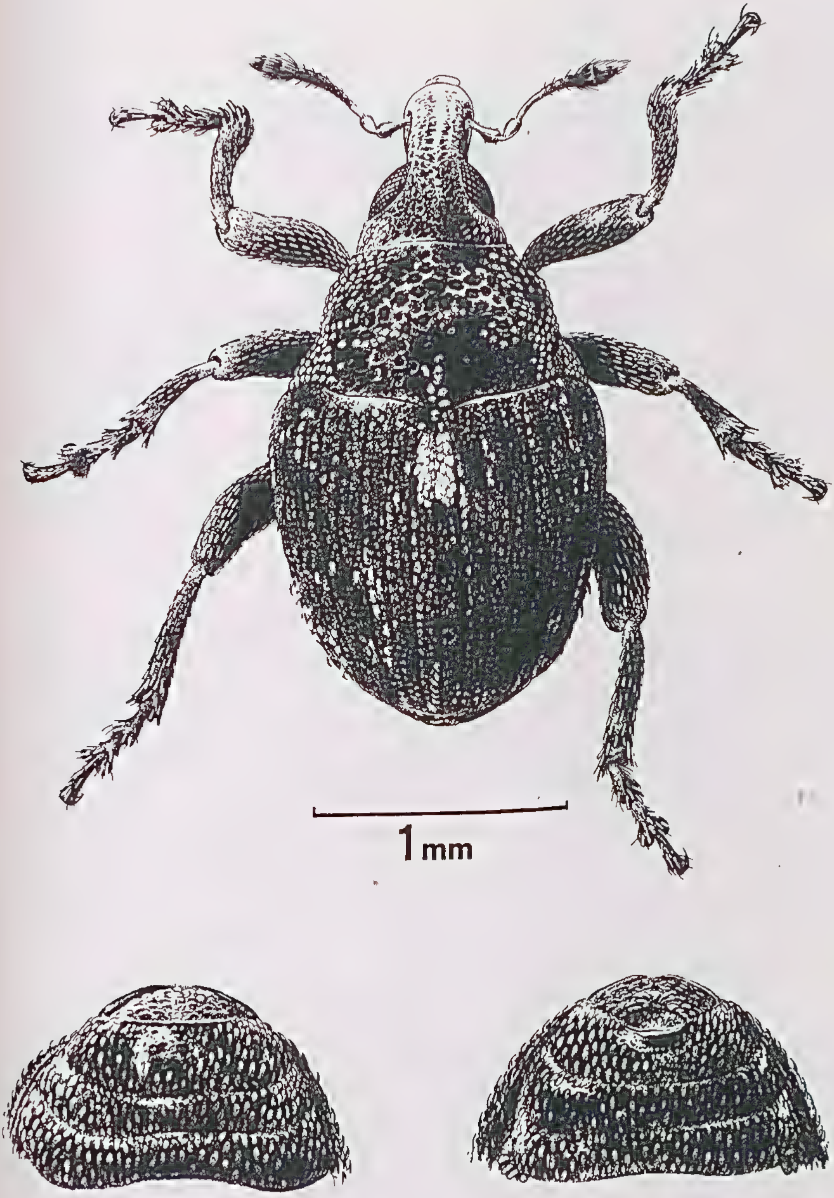
Feeding commenced within several hours of emergence and was observed on all plant parts except roots, mature fruit and male flower clusters. Irregularly-shaped feeding holes up to 2 mm diameter were made in the lamina. Feeding pits made on other plant parts were up to 2 mm long and 1 mm wide and caused damage to epidermal and vascular tissue.

Adults lived for a considerable time, four out of eight males and four out of eight females lived for more than 100 days. Males lived as long as 245 days and females as long as 191 days. Unfed adults had all died within 23 days while adults fed for eight days and then starved, had all died within 49 days.

Oviposition. The mean pre-mating period was 2.5 days (range 2-3) and pre-oviposition period 6 days (range 4-8). Repeated copulation occurred frequently throughout the duration of the ovipositional period.

Thirty-eight percent of eggs laid were found on stems of the host, 26% on petioles, and 20% on the soft pericarp of developing fruit; of the remainder, 7% were found on laminae, 5% on midribs, and 4% on female flowers. Eggs were deposited singly in small pits, sometimes with part of the egg protruding above the epidermal layer and often the egg and pit were covered with a black excretion.

In the laboratory an average of 3.6 eggs (range 1.8 - 5.9) was laid per day. Oviposition continued for up to 146 days with four out of eight individuals



Figs 1-3. *Rhinoncus australis* Oke: (1) adult; (2, 3) abdomen, ventral view, showing 3rd, 4th and 5th ventrites and pygidium, (2) ♀, (3) ♂.

having an oviposition period longer than 100 days. As many as 579 eggs were laid by one female and four out of eight females produced more than 290 eggs each.

Eggs. Eggs were oval in shape, 0.58 x 0.40 mm, and finely reticulated. They were cream coloured following deposition and darkened during the first 24 hours. Eggs hatched after 4 days (range 2-7) (Table 1).

TABLE 1

Duration of developmental stages of *Rhinoncus australis*

Stage	Duration (days) mean	range
Pre-oviposition period	6	4 - 8
Incubation	4	2 - 7
Larva	30	27 - 32
Pupa	5	5 - 6
Time between generations	45	38 - 53
Oviposition to emergence of adult	39	34 - 45

Larvae. Completion of larval development took an average of 30 days (range 27-32) (Table 1). There were three larval instars, distinguished by head capsule width measurements. The mean head capsule width for the first instar was 0.24 mm, second instar 0.36 mm and third instar 0.54 mm (Fig. 4).

After hatching, larvae tunnelled into the vascular tissue of the plant stems under the epidermis, generally in a longitudinal direction. Larger larvae tunnelled into both vascular and pith tissues and also around the circumference of stems at each node beneath the petiole sheath. There was a general tendency for third instar larvae to tunnel towards the base of stems. Many eggs were deposited on developing fruit but tunnelling by the larvae was not observed to damage the developing embryo. Larvae in the fruit, midribs, and petioles tunnelled towards and into stems.

The average length of final instar larvae was 3.7 mm (range 2.8 - 4.2).

Pupae. Pupae averaged 2.8 mm (range 2.4 - 3.3) long. Two methods of pupation were observed in the insectary: (1) in pupal chambers within the stem material; (2) in pupal cases within hollowed out stem sections. Pupal cases were a construction of frass material secreted together to form a shell. They were constructed by the final instar larvae and were irregularly oval in shape, measuring 3.0 x 2.0 mm. Larvae and pupae taken from chambers and cases developed similarly on moist filter paper and adults emerging from chambers and cases fed and oviposited normally. In the field pupation occurred in chambers and no pupal cases were found. Pupal cases may be an artifact of high density insectary rearing.

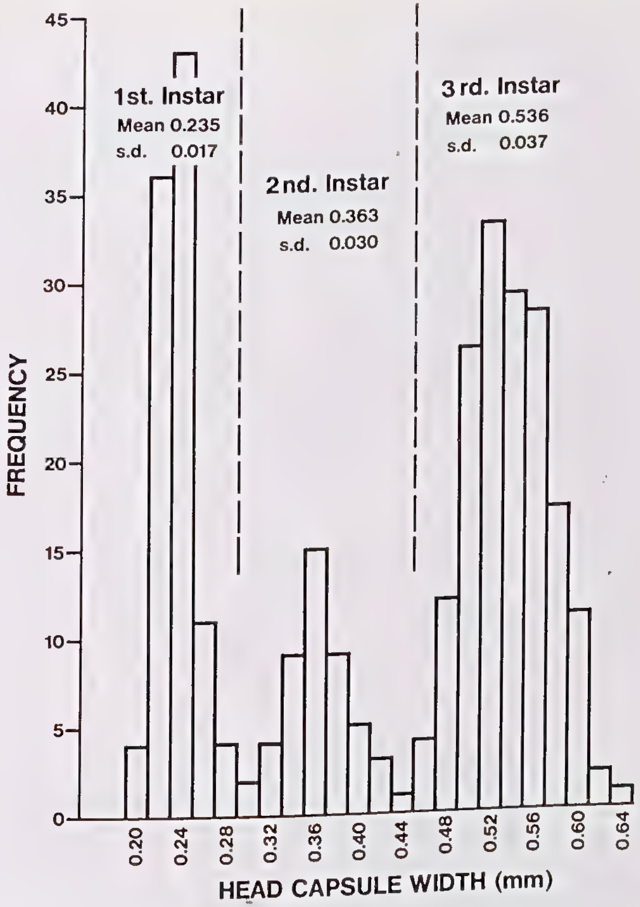


Fig. 4. Separation of larval instars of *Rhinoncus australis* Oke by head capsule widths and the mean, standard deviation and predicted limits for each instar.

Field observations

R. australis appears to restrict its attack to plants of the family Polygonaceae. Since *E. australis* is the only representative of this plant family occurring at several localities where *R. australis* was found, *R. australis* has apparently broadened its distribution, at least locally, using this introduced weed as host. In these areas adults apparently survive for up to seven months between *E. australis* growing seasons, in the absence of alternative host plants.

In insectary cages, *R. australis* severely damaged *E. australis*: plant growth was retarded, seed production reduced and longevity shortened. During 1977 field cage studies were carried out to assess the value of the introduced weevil, *P. antiquum*, as a biological control agent for *E. australis*. *R. australis* was observed attacking the caged plants both in the presence and absence of *P.*

antiquum while in other cages plants remained unattacked by either weevil. Plant assessment indicated that no significant effect on growth or seed production of the caged field plants occurred as a consequence of *R. australis* attack.

R. australis and *P. antiquum* attack and damage *E. australis* in a similar manner. However, attack by these species can be distinguished in the field. Feeding by adult *P. antiquum* is generally restricted to the midrib and upper petioles and causes regular, circular, "shot-holes" in the lamina. *R. australis* feeding is more general and includes stems, the pericarp of developing fruits, and female flowers; feeding holes in the lamina are slightly larger and more irregular and cause a ragged effect. Both species deposit eggs in pits. Plant reaction often produces raised scar tissue around *R. australis* eggs, but none is produced around *P. antiquum* eggs. *P. antiquum* emergence holes are neat, circular, occur along the length of stem, and, except under high populations, there is approximately one hole per emerging adult. *R. australis* emergence holes are slightly larger and less regular and are generally found in the lower two or three internodes. Only two or three emergence holes are cut when numerous adults of *R. australis* emerge from a stem.

Small numbers of immature stages of the weevil were present in *E. australis* during winter but very few adults were observed. Oviposition and development appear to be restricted by the low winter temperatures that occur throughout the range of *E. australis.* Although the weevil populations increased in spring and early summer, this was too late in the growing season to prevent growth or to affect seed production.

Discussion

In an evaluation programme for the biological control of the weed *E. australis* it was recognised that *R. australis* occupies a similar niche to that of *P. antiquum.* Because of the low *R. australis* field populations it is unlikely that interspecific competition will influence the establishment or effectiveness of *P. antiquum.* It is concluded that in the field *R. australis* has no effect on density or reproductive efficiency of *E. australis.*

Acknowledgements

The authors thank Mr Stan Fiske for the illustrations, Dr K. L. S. Harley for reading the manuscript and Dr E. C. Zimmerman for identifying specimens.

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THE POSITION OF *SIGMATONEURA* ENDERLEIN (PSOCOPTERA: PSOCIDAE)

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Abstract

Evidence based on a re-examination of Australian material is presented supporting transfer of *Sigmatoneura* Enderlein from the Cerastipsocini to the Metylophorini.

In the currently used classification of the Psocidae the subfamily Cerastipsocinae includes three tribes, the Cycetini (*Cycetes* Enderlein), Cerastipsocini (*Cerastipsocus* Kolbe, *Clematoscenea* Enderlein, *Eremopsocus* McLachlan, *Psococerastis* Pearman and *Sigmatoneura* Enderlein) and Metylophorini (*Diplacanthoda* Enderlein, *Brachinodiscus* Enderlein, *Metylophorus* Pearman, *Pearmania* Badonnel and *Pilipsocus* Badonnel). Roesler (1944) included *Podopterocus* Banks and *Dinopsocus* Banks as subgenera of *Eremopsocus* but Mockford (1975) has suggested retention of these groups as genera until further studies are made.

The Cycetini are easily distinguished from other Psocidae by the fusion of R_{4+5} with the media in the fore wing.

The Cerastipsocini can be characterized mainly by (1) the short fourth segment of the maxillary palp, (2) the pointed apex of the dorsal valve of the gonapophyses, (3) the sclerification and, hence, colour pattern of the subgenital plate including a "tuning-fork" or "vase" shaped element which extends into the posterior lobe of the plate and (4) the sclerification of the spermathecal entrance being in the form of a simple ring around the entrance (Pearman 1932, figs 29 G, S, PG; Mockford 1975, figs 11-14, 16, 17).

In the Metylophorini characteristic features are (1) the distal segment of the maxillary palp is long ($>$ 2.5 long as broad), (2) the distal end of the dorsal valve of the gonapophyses is broad and rounded, (3) the pattern on the subgenital plate does not include a "vase" shaped or "tuning-fork" shaped element but does include a "T" in which the lateral arms are broadened towards the end and (4) the sclerification of the entrance to the spermatheca includes a rod-like sclerite in addition to the ring surrounding the entrance (Pearman 1932, figs 30, P, S, PG).

Roesler (1944) placed *Sigmatoneura* Enderlein as a subgenus of *Cerastipsocus*. Smithers (1976), on the basis of Australian material, considered that *Sigmatoneura* should be regarded as a distinct genus. Re-examination of this material in connection with obviously Cerastipsocine species from New Guinea has further emphasized the differences between *Sigmatoneura* and *Cerastipsocus*. The fourth segment of the maxillary palp is long, the dorsal valve of the gonapophyses is broadly rounded, the subgenital plate pattern is in the form of a "T" and the sclerification of the entrance to the spermatheca includes a rod-like sclerite. The affinities of *Sigmatoneura* are clearly with *Metylophorus* rather than *Cerastipsocus*. Not only should it be regarded as a genus distinct from *Cerastipsocus* but it should be removed from the Cerastipsocini and be placed in the Metylophorini as currently defined.

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FIRST RECORD OF *CHARAXES LATONA* BUTLER (LEPIDOPTERA: NYMPHALIDAE) FROM AUSTRALIA

By S. J. Johnson *and* M. De Baar

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Abstract

Three specimens of *Charaxes latona* Butler (Lepidoptera: Nymphalidae) are recorded from Cape York, northern Queensland, these being the first Australian record for this butterfly. The subspecific status of the Australian specimens is uncertain.

Introduction

Charaxes latona Butler is a large, fast flying, and conspicuous nymphalid butterfly which is widely distributed within the Australian region. It occurs on Bachan, Halmahera, and Obi Islands in the Moluccas, the Aru Islands, mainland West Irian and Papua New Guinea, Fergusson and Goodenough Islands in the D'Entrecasteux group, the Bismark Archipelago, and Bougainville in the Solomon Islands. D'Abrera, (1978) recognises 13 subspecies from the region.

In June and July, 1978 three males were taken, and others observed flying, in rain forest at Iron Range, Cape York Peninsula, a well known area which has been subjected to extensive collecting in recent years (Monteith and Hancock, 1977).

Material

2 ♂, Iron Range, 29.vi.1978, 7.vii.1978 M. De Baar (in De Baar Collection); 1 ♂, Iron Range, 3.vii.1978, D. Washbourne (in S. J. Johnson collection).

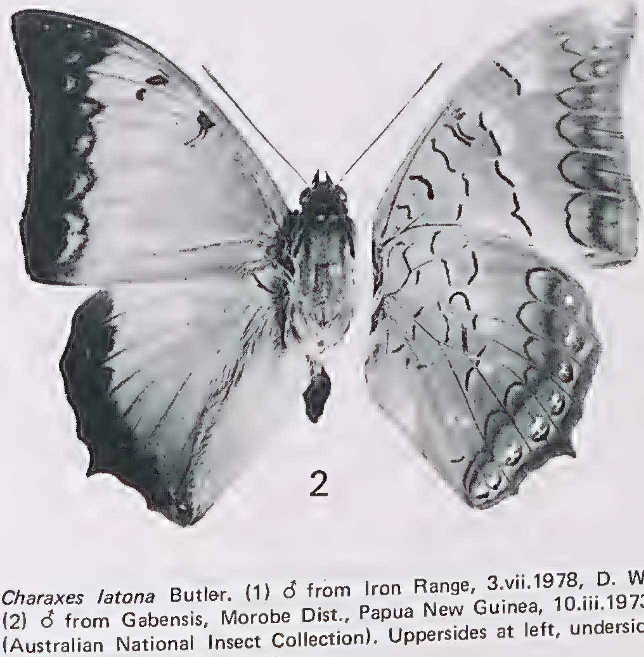
Discussion

The adult males taken, and those observed, were flying along the margins of rain forest particularly on the summits of ridges and hills in the area adjacent to Mt. Lamond. The flight behaviour was very similar to that of the closely related *Polyura pyrrhus* (Fabricius) which was flying with *C. latona.* Both species exhibited aggressive territorial behaviour. They alighted on leaves usually six metres or higher above the ground, and rested in a characteristic head down position with wings held erect over the body.

The Australian specimens appear to differ from mainland New Guinea specimens in the width of the dark margins of the wings. The fore wing dorsal dentate submarginal band on the Australian specimens is less developed and further from the dark margin than in specimens from mainland New Guinea (compare Fig. 1 with Fig. 2). On the hind wing, the dorsal submarginal spot between CuA_1 and CuA_2 is poorly developed in the Australian specimens compared to New Guinea specimens.

There appears to be no significant difference between the underside patterns of the Australian specimens and those of the nearest New Guinea subspecies. Underside pattern and hind wing tail development in New Guinea

1



2

Figs 1-2. *Charaxes latona* Butler. (1) ♂ from Iron Range, 3.vii.1978, D. Washbourne; (2) ♂ from Gabensis, Morobe Dist., Papua New Guinea, 10.iii.1973, D. Sands (Australian National Insect Collection). Uppersides at left, undersides at right; slightly larger than natural size.

populations varies considerably between specimens from the same locality over a period of two months (Fenner, pers. comm.).

Owing to the uncertainty of the subspecific status of available New Guinea material and the scarcity of Australian specimens, we have decided to leave the subspecific status of the Australian specimens unresolved.

Acknowledgements

We are greatly indebted to Mr T. L. Fenner for his detailed comparison of photographs with specimens in the Central Reference Insect Collection, Department of Primary Industries, Konedobu. We also wish to thank Dr I. F. B. Common and Mr John Green for preparing photographs of the specimens figured.

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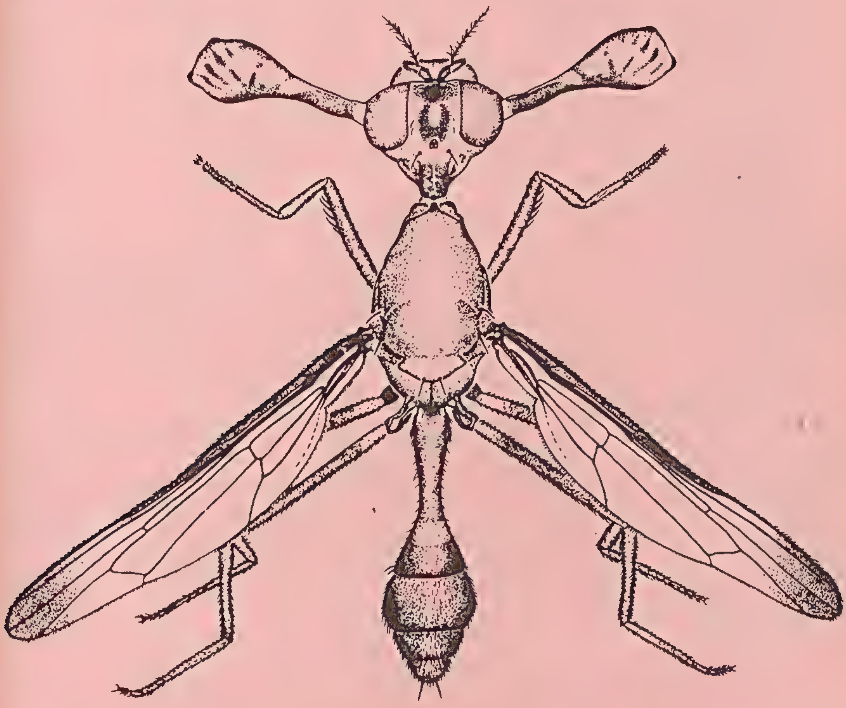

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COVER

Illustrated by Margaret Schneider.

This spectacular fly, *Phytalmia mouldsi* McAlpine and Schneider, is the sole representative of the genus in Australia. It is known only from the rain forests of the Iron Range district of Cape York Peninsula. Other species, some even more spectacular in appearance, occur in New Guinea and neighbouring islands. It is only the males that bear the amazing head projections which they use as contact areas when fighting for territorial and courtship rights.

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UNEXPECTED SYNONYMY IN CHLOROPIDAE, FROM THE FAMILY EPHYDRIDAE (DIPTERA)

By Curtis W. Sabrosky
Systematic Entomology Laboratory, IIBIII, Agricultural Research,
Sci. & Educ. Admin., U.S. Dept. of Agriculture*

Abstract

Ectropa viduata Schiner, 1868, described from Sydney as an ephydrid, proved from examination of the holotype (Vienna Museum) to be the chloropid known as *Lasiopleura fuscipes* (Malloch), also described from Sydney. *Ectropa* is preoccupied and was renamed *Apotropina* Hendel, 1907, and this name antedates the well known names *Lasiopleura* and *Parahippelates*, the former in particular recorded from all faunal regions.

Schiner (1868) in the Diptera of the *Novara* Reise described a new genus and new species, *Ectropa viduata*, for a single specimen from Sydney, Australia, placed in the Ephydrinae and compared with the well-known ephydrid genera *Ochthera* and *Pelina*. Hendel (1907) recognized that *Ectropa* was preoccupied by *Ectropa* Wallengren, 1863, in the Lepidoptera and renamed it *Apotropina*, without comment on its family position. Tillyard (1926) merely listed it in the Ephydridae, and it was not mentioned by Colless and McAlpine (1970), nor by J. R. Malloch in his numerous papers on the Australian acalyptrate Diptera (cf. Lee, Crust and Sabrosky, 1956).

My attention was directed to *Ectropa* by way of correspondence between Wayne Mathis of the Smithsonian Institution, interested in Ephydridae, and D. K. McAlpine of the Australian Museum, who guessed from the description that it might be a chloropid of the genus *Lasiopleura* Becker, 1910. Through the kindness of Dr Ruth Lichtenberg of the Naturhistorisches Museum in

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*C/- U.S. National Museum of Natural History, Washington, D.C. 20560, U.S.A.

Vienna, I have now been able to examine the holotype of *Ectropa viduata* Schiner, a female in excellent condition, and I can confirm that it is indeed a *Lasiopleura* sens. lat. (*Parahippelates* Becker 1911). This genus must thus be known as *Apotropina* Hendel (new synonymy).

Andersson (1977), in a detailed taxonomic and phylogenetic study of Old World Chloropidae, especially based on male genitalia, accepted Duda's subfamily Siphonellopsinae for five genera, including *Siphonellopsis* Strobl, *Lasiopleura* Becker, *Parahippelates* Becker (resurrected from the synonymy of *Lasiopleura*), and two new genera founded entirely or partly on species previously described in *Lasiopleura.* However, six named Old World genera and two New World genera of Siphonellopsinae were not studied, and it would appear that one should be cautious about proposing new genera with so many possibilities still unstudied. He also expressed the view that "a considerable increase in the number of valid genera will follow" further studies in this subfamily. This is possible, but it is also possible that apparent generic distinctions will disappear or become blurred when more species are studied in the great diversity of *Lasiopleura* sens. lat., now *Apotropina.* I have seen a large number of species from various parts of the world, and this appears to be an old, primitive, and widely distributed group of characteristic habitus.

This species, now *Apotropina viduata* (Schiner), proved to be that described by Malloch (1924: 330) as *Parahippelates fuscipes,* also from Sydney (new synonymy). The holotype of *fuscipes* is in the Australian Museum, and I have paratypes before me in the United States National Museum of Natural History. I dissected the male genitalia of a paratype and found that it is *Parahippelates* in Andersson's sense, so that even if Andersson's restricted use of *Lasiopleura* is followed, *Parahippelates* at least will fall as a junior synonym of *Apotropina.*

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A NOTE ON BUTTERFLY CAPTURES AT BAYVIEW, NEW SOUTH WALES

By L. Courtney Haines
10 Loquat Valley Road, Bayview, N.S.W. 2104

During the past few years I have made interesting captures of three butterfly species which are considered rare in Sydney. Details of these captures are given below.

Hasora Khoda haslia Swinhoe

On the night of 17 February 1973 I found my sister's cat playing with something under the lamp of her front porch. On closer examination it proved to be a perfect female *H. khoda haslia.*

My next capture of the species was at dusk on 10 December 1973 and since that date I have taken it regularly each summer. The species here at Bayview is mostly crepuscular and flies to my buddleias which grow just outside my front door. I also find the butterfly resting beneath the leaves of my exotic trees during the day and sometimes on the brickwork under the house. It is usual for me to capture only single specimens at night, but on 5 January 1976 I collected two within a minute or so, and since that date I have taken several during warm twilight evenings, sometimes in a single sweep of my large kite net.

At present I have a series of 83 specimens from Bayview, containing 37 males and 46 females taken during the months of December, January and February. Adults, however, can be found throughout the year. *H. khoda haslia* is also attracted to Lobelia flowers, and it is very easy to net specimens as they suck the nectar.

The larvae are thought to feed on native wisteria, *Millettia megasperna,* which probably grows here in Loquat Valley with its subtropical climate. I have no doubt that the butterfly is breeding locally as the majority of specimens that I have collected or seen have been remarkably fresh in appearance. Despite constant searching I have not found larvae on the garden wisteria.

This large and striking skipper, has previously been recorded from Noosa, Queensland, to Sydney where it is generally considered a rarity (Common and Waterhouse, 1972).

Telicota colon argeus (Plotz)

On 31 March 1972 I took a single male of this skipper which came to flowers in my garden. This species is a rare visitor to Sydney.

Danis hymetus taygetus (C. & R. Felder)

Since I first reported captures and observations of this butterfly at Bayview during the years 1968 and 1970 (Haines, 1969; 1972), *D. hymetus taygetus* has increased in numbers to such an extent, that until recently, it was by far the most common butterfly in Bayview. It seems to confine itself almost exclusively to Loquat Valley.

Here at Bayview the larvae feed on the leaves of the red ash, *Alphitonia excelsa,* and as I have a tree of this species growing alongside my cottage, the butterflies constantly fly about my garden and I rarely need to leave my front porch to secure specimens. I now possess a series of 195 and could easily double this if I so desired. Adults occur throughout the year but are most plentiful during the autumn and early winter.

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LIST OF ENTOMOLOGISTS AND RELATED SPECIALISTS

Dr Kent H. Wilson is assembling data on the entomologists of the world; authors, collectors, dealers, acarologists, and related specialists. The purpose is to establish a data bank. Should you wish to be included write to Dr Wilson at P.O. Box 1097, Edmond, Oklahoma 73034, U.S. A.

AN ACCUMULATIVE BIBLIOGRAPHY OF AUSTRALIAN ENTOMOLOGY

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A guide to the
BEETLES OF SOUTH-EASTERN AUSTRALIA

by

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B.Sc., Ph.D., D.Phil.

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FOREWORD

For many years there has been a need for a book on Australian beetles, particularly one designed for the layman and amateur Coleopterist. It is anticipated that the present work will, in part at least, fulfil this need.

The last decade has witnessed an increasing awareness of Australian natural history. Many beautiful books have been published on this subject and the number appears to be increasing. Never before has the Australian naturalist had so many authoritative works at his disposal. These cover a very wide range of topics and insects have had a share of this attention. Apart from butterflies, however, there have been few titles covering a particular insect group in depth, and conspicuously absent, both today and in the past, has been any popular style book on Australian beetles. This large group of common, often spectacular and sometimes beautiful creatures has received little attention in our natural history books. Apart from a large chapter in C.S.I.R.O.'s *Insects of Australia*, other comprehensive treatments of Australian beetles have all appeared as research papers in scientific periodicals.

The present book, it is hoped, will ease this problem to a considerable degree. For the first time naturalists and amateur Coleopterists will have available to them a detailed treatment of the beetle fauna in a language that is easily understood yet still follows a scientific approach. The large number of illustrations will assist in the identification of several hundred of the more common and interesting species found in south-eastern Australia. Dr Moore is a professional scientist whose enthusiasm for beetles is reflected in the pages of this book. Not only is his knowledge of the subject wide as the text shows, but the superb line drawings and some of the coloured plates illustrating the text are also by his own hand.

The book is being published as fascicles in *Australian Entomological Magazine* as text and illustrations for each section are completed. In this way readers will have available to them at the earliest possible date information which otherwise would have been withheld for several years pending the author's completion of the whole work. These fascicles are designed as entities independent of the journal so that they may be removed and eventually bound together to form a complete book. The first fascicle contains 20 pages; subsequent fascicles will each contain 16 pages.

M. S. MOULDS

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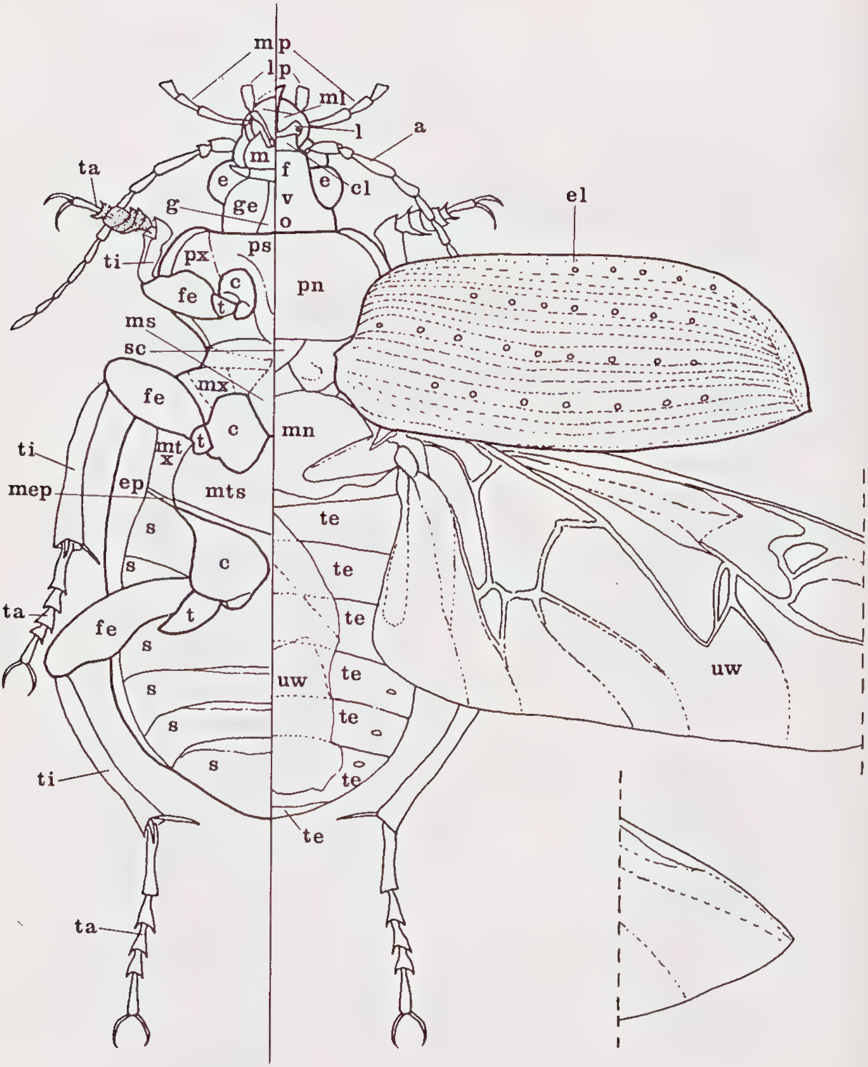


Fig. 1. Right underside and right upperside of a carabid beetle (*Calosoma schayeri*) to show the principal parts: a, antenna; **c**, coxa; **cl**, clypeus; **e**, eye; **el**, elytron; **ep**, epipleuron; **f**, frons; **fe**, femur; **g**, gula; **ge**, gena; **l**, labrum; **lp**, labial palpus; **m**, mentum; **mep**, metepimeron; **ml**, mandible; **mn**, metanotum; **mp**, maxillary palpus; **ms**, mesosternum; **mts**, metasternum; **mtx**, metepisternum; **mx**, mesepisternum; **o**, occiput; **pn**, pronotum; **ps**, prosternum; **px**, proepisternum; **s**, sternite; **sc**, scutellum; **t**, trochanter; **ta**, tarsus; **te**, tergite; **ti**, tibia; **uw**, underwing; **v**, vertex. (Inset = tip of underwing.)

WHAT IS A BEETLE ?

Beetles or Coleoptera, to use their scientific name, are amongst the most highly developed insects. Like the better known butterflies and moths (Lepidoptera) and also the bees, wasps and ants (Hymenoptera) and the two-winged flies (Diptera), their life histories show a complete metamorphosis, that is to say, the active, growing (larval) stages bear little resemblance to the adult insects and are separated from them by an inactive pupal phase. Beetles are also characterised by the possession of biting (rather than sucking) mouthparts.

The word Coleoptera is derived from the Greek *Koleos* + *pteron* and means, literally, 'sheath-wing' —an allusion to the completely opaque, leathery or horny fore wings that most beetles possess. These hardened fore wings, or ***elytra*** (singular: ***elytron***) as they are termed, generally play little or no part in flight and when at rest, are normally folded backwards to meet along their inner edges, thus completely covering and protecting the delicate underwings and often much of the hindbody as well. Indeed, in many flightless species, the elytra are permanently soldered together and the underwings have then almost or entirely disappeared.

Few other groups of insects are likely to be confused with beetles. Cockroaches (which form a separate Order, Blattodea) are sometimes mistaken for them at first glance but the fore wings of those species that still possess them are only partly darkened and are functional in flight. Earwigs (Dermaptera) have short elytra and might be mistaken for beetles belonging to the family Staphylinidae but the latter do not have prominent anal forceps. Earwigs, like cockroaches, show little metamorphosis. Some of the shield-bugs (Hemiptera) have a hard integument and superficially resemble beetles but their fore wings are hardened only in the front half (to form hemielytra) and their mouthparts are of the tubular, sucking type, virtually unknown in beetles.

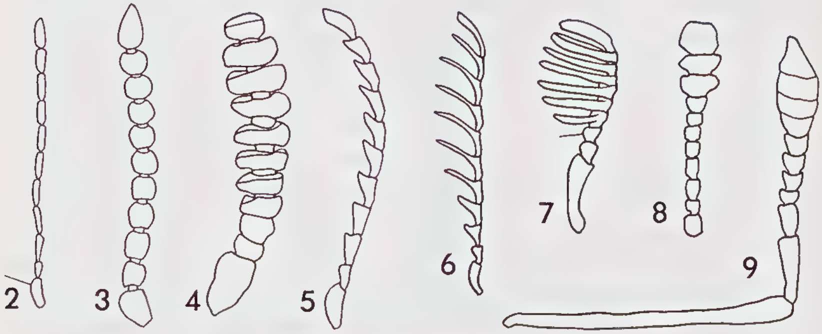
Beetle anatomy

A. The adult (Figs 1 - 15)

The body, like that of any other insect, is divided into three main portions, the ***head***, ***thorax*** and ***abdomen***. The head carries the many-faceted eyes (except in a few blind species that have secondarily lost them), the antennae and the mouthparts. The last-mentioned comprise a pair of ***mandibles***, used for cutting and/or crushing the food, a pair of secondary mandibles, the ***maxillae***, which manipulate the food, an upper lip, the ***labrum***, and a lower lip, the ***labium***, of which the main part is the basal plate or ***mentum*** (Fig. 1). Typically there are two pairs of sensitive appendages or ***palpi*** (singular: ***palpus***), one pair associated with the maxillae and the other with the labium. The antennae and palpi carry organs of smell, taste or touch and are constantly in use, the former to monitor the immediate environment of the beetle and the latter to investigate potential food or mates.

The antennae vary enormously in length and form; they are normally 11-segmented but reduction in segmentation occurs in certain groups. Two extremes of development are illustrated by the Hydrophilidae and Cerambycidae. In the former the antennae are generally shorter than the maxillary palpi (which have apparently usurped their sensory role), whereas in the latter they are frequently much longer than the whole body. The principal types of antennae are illustrated in Figs 2-9; they range from the simple filiform (thread-like) organs present in most Carabidae and many Chrysomelidae, etc., to beautiful flabellate (multi-leaved) structures characteristic of male Rhipiceridae. Not infrequently, the antennae differ markedly in size and development between the sexes in individual species and in such cases, those of the male are usually the more elaborate.

The beetle's thorax is subdivided into three segments, the ***prothorax***, which is the very obvious middle section of the animal (behind the head), the ***mesothorax*** and the ***metathorax***. The articulation of the prothorax is frequently movable but the meso- and meta- thorax are more or less combined with the abdomen, to form the 'hindbody'. Each segment of the thorax carries a pair of legs; the elytra are borne by the mesothorax and the underwings (when present) by the metathorax. When the elytra are closed the metathorax is usually entirely invisible from above but a small triangular area (the ***scutellum***) of the mesothorax is normally visible between their bases. The underwings, when at rest, are folded both transversely and longitudinally in order to fit within the space beneath the much shorter elytra. The hinges present in the main wing-veins, which facilitate this folding,

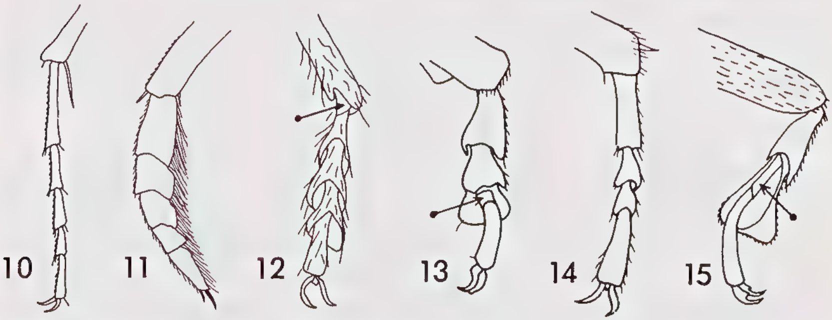


Figs 2-9. Antennae. (2) filiform (*Oodes modestus*, Carabidae); (3) moniliform (*Leoglymmius lignarius*, Rhysodidae); (4) moniliform-perfoliate (*Uloma westwoodi*, Tenebrionidae); (5) serrate (*Balanophorus brevipennis* ♀, Melyridae); (6) pectinate (*Balanophorus janthinipennis* ♂, Melyridae); (7) lamellate-clavate (*Syndesus cornutus* ♂, Lucanidae); (8) clavate (*Thallis comptus*, Erotylidae); (9) geniculate-clavate (*Orthorhinus cylindrirostris*, Curculionidae).

differ markedly in disposition from one lineage of beetles to another and are useful in solving problems of classification.

The abdomen is composed of from 7-9 visible segments and encloses the digestive and reproductive organs; its upper surface is normally weakly pigmented and soft, being covered by the elytra, except during flight. However in some families (e.g., Histeridae and Scarabaeidae) the terminal segments (which form the ***pygidium***) are permanently exposed. In most Staphylinidae the elytra are exceptionally short and much of the hindbody is visible from above, the exposed segments being more heavily armoured than is normally the case.

The cuticle is largely composed of a matrix of two natural polymers, protein and chitin, which have been more or less hardened and darkened by a kind of tanning process, termed ***sclerotisation***. The degree of sclerotisation varies to some extent with the age of the beetle, newly emerged 'callow' specimens being noticeably soft and pale in colour; it also varies from group to group. Thus the Soldier beetles (Cantharidae) are notable for their soft, pliable cuticle, whereas mature Histeridae are exceptionally heavily armoured, with closely interlocking and articulating plates (***sclerites***) of exceedingly hard and resistant cuticle. Likewise, the surface structure of the cuticle can vary widely between groups, from perfectly smooth and shiny to heavily sculptured and matt; from completely unadorned to intricately patterned with scales or densely pubescent.



Figs 10-15. Left hind tarsi. (10) pentamerous (*Pamborus alternans*, Carabidae); (11) pentamerous but adapted for swimming (*Homoeodytes scutellaris*, Dytiscidae); (12) pseudo-tetramerous (arrow shows obscure first segment) (*Zenithicola crassus*, Cleridae); (13) pseudo-tetramerous (arrow shows obscure fourth segment) (*Augomela hypochalcea*, Chrysomelidae); (14) tetramerous (*Cardiothorax howitti*, Tenebrionidae) (note: the fore and mid tarsi are pentamerous in this family); (15) pseudo-trimerous (arrow shows obscure third segment) (*Cleobora melleyi*, Coccinellidae). Figs not all to same scale.

The legs are divided into five sections of which the basal one, the ***coxa***, articulates with the body as a 'ball-and-socket' joint. The second section, the *trochanter*, is a minor segment and is followed by the *femur*, which is usually the most robust section of the leg. Next follows the *tibia* and lastly the *tarsus* or foot.

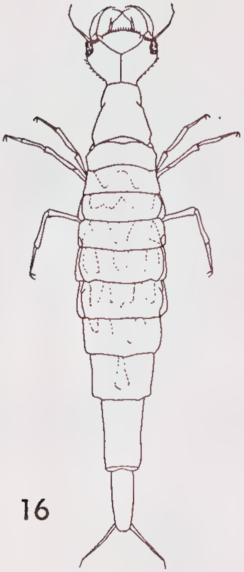
The beetle tarsus is most commonly composed of five segments, the last (terminal) bearing a pair of well marked claws (Figs 10-13). However, in a few families the segments are reduced to four (e.g., in Heteroceridae) or even three (Pselaphidae) and in some weevils the claws are absent. In the important family Tenebrionidae and its allies, the hind tarsus carries only four segments (Fig. 14) but the others have five and these beetles are therefore said to be 'heteromerous'. Occasionally, too, the tarsal formula as it is called, may vary within a family (e.g., Staphylinidae) or even between the sexes of a given species (e.g., in certain Cucujidae). In general, however, it affords a very useful guide to family relationships. Sometimes one of the segments (often the penultimate) is very small and being tucked between the lobes of the one before, is easily overlooked. This is the case with Leaf beetles (Chrysomelidae) (Fig. 13), Longicorns (Cerambycidae), Weevils (Curculionidae) and many others, where the tarsi are actually five-segmented but appear to possess only four segments (i.e., they are pseudo-tetramerous). Likewise, Ladybirds (Coccinellidae) (Fig. 15) have four-segmented tarsi but only three segments are readily apparent (pseudo-trimerous).

Tarsal formulae therefore afford an important aid in preliminary identifications and they are normally quoted in the form: 5-5-5 (all five-segmented = pentamerous); 4-4-4 (all four-segmented = tetramerous); 3-3-3 (all three-segmented = trimerous); 5-5-4 (heteromerous); 0-5-5 indicates that the fore tarsus is wanting altogether (a condition present in some burrowing Scarabaeidae) and 5*-5*-5* or 4*-4*-4* denote such cases mentioned above, where one of the segments is not readily apparent.

B. The early stages (Figs 16 - 23)

The eggs of most beetles are laid in soil, wood, or some other substrate and in such cases, they are generally soft, simple in form and unadorned. However those of many Coccinellidae and Chrysomelidae are frequently laid on plant stems or in other exposed situations and they usually show a firmer texture, with more pronounced pigmentation and, in some cases (such as *Paropsis*, Chrysomelidae) highly characteristic sculpture. Some Carabidae enclose their eggs in individual earthen cases.

Beetle larvae show the same divisions of the body as do the adults but of course, they lack elytra and underwings; eyes when present, take the form of simple ocelli (stemmata), with limited powers of perception, through a single lens. These larvae vary greatly in form, according to their habits, and they may change considerably in these regards, during the course of growth. However, four main types may be distinguished according to build and level of mobility; these are termed campodeiform, eruciform, scarabeiform and apodous, respectively.



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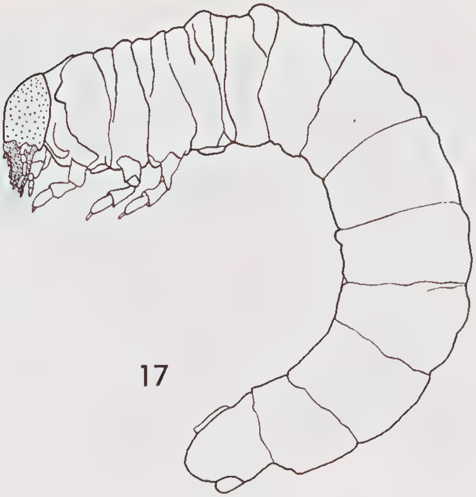

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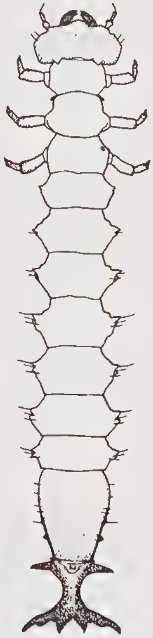

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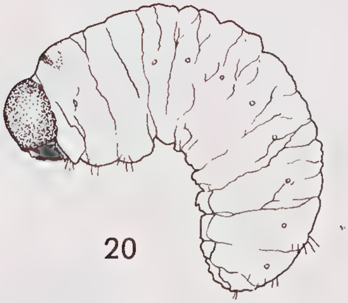

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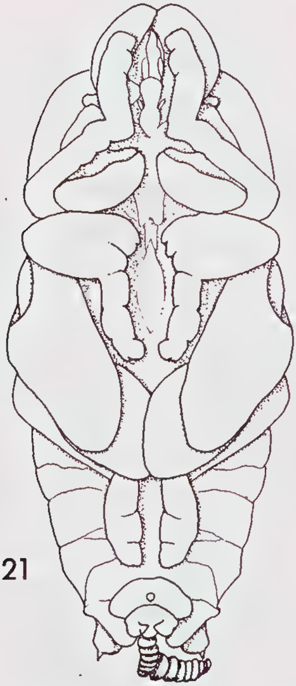
Figs 16-20. Beetle larvae. (16) *Hydaticus parallelus* (Dytiscidae); (17) *Syndesus cornutus* (Lucanidae); (18) *Platisis* sp. (Cucujidae); (19) *Augomela hypochalcea* (Chrysomelidae); (20) *Phalidura assimilis* (Curculionidae).

Campodeiform larvae (Figs 16, 18) are lithe, active creatures with long, slender legs and they often trail a pair of long appendages (variously called cerci, urogomphi, etc.) from the end of the abdomen; they are characteristic of the predacious families, Carabidae, Staphylinidae, etc. Eruciform larvae (Fig. 19) are much less active and more grub-like, with shorter legs and stouter bodies and their terminal appendages, if present, are very small; larvae of the various plant-eating beetles are typical examples. Scarabaeiform larvae (Fig. 17) are C-shpaed and include the well known 'curl grubs' of garden lawns; larval Lucanidae (Stag beetles) and Ptinidae (Spider beetles) are also of this form. The fourth type, the apodous (Fig. 20), comprises reduced, legless forms that normally spend their entire developmental period encased within their food (such as seed-capsules, plant stems or rotten wood); this is the usual form in the great weevil family Curculionidae.

Most beetle pupae are *exarate*, that is rather soft and pale, with the appendages more or less free (Figs 21, 22); their duration is short (a matter of only a few weeks) and they usually lie in a protective cell, in the remains



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Figs 21-23. Beetle pupae. (21) *Lamprima aurata* ♂, ventral (the spiral anal appendage accommodates the long penile flagellum (Lucanidae); (22) *Saprinus australasiae*, lateral (Histeridae); (23) *Helmus bilunatus*, dorsal (Coccinellidae).

of the food or in the soil, and provided by the larva before it transformed. Ladybird (Coccinelidae) pupae are exceptional in being ***obtect***, that is strongly sclerotised, with the appendages more or less fused to the body, after the manner of the butterfly chrysalis, and like the latter, they remain exposed, attached to plant surfaces, etc. (Fig. 23). Some of the adult structures can always be made out in beetle pupae and in the pale forms, the eyes darken noticeably a few days before the emergence of the callow adult. The latter usually remains inactive in the pupal cell for a considerable period in order to allow the new cuticle to harden and darken to its final texture and hue.

BEETLE BIOLOGY

General

In terms of numbers of species (though perhaps not in individuals) beetles form by far the largest group of animals. This is a measure of their adaptability to a wide variety of habitats and ways of life. Only the restless open sea has resisted them but brackish pools are certainly frequented by some Hydrophilidae and Dytiscidae and the littoral zone is home for several specialised Staphylinidae and Carabidae. Quite a number of the latter family are entirely restricted to the margins of saline lakes and saltpans in the drier regions of Australia.

Some 500 of our native beetles are more or less adapted to life in fresh water. Of these the Dytiscidae, Gyrinidae and some other minor families are entirely aquatic, both as larvae and adults, and many Hydrophilidae are similarly adapted. The adults of these beetles all share a smooth, hydrodynamic form, and their hind legs (and sometimes also mid legs) are adapted as oars for swimming (e.g., Fig. 11); they breathe from air stores carried in various recesses (e.g., under the elytra, between head and thorax, etc.) and renewed periodically at the surface. A few plant-feeding Chrysomelidae and Curculionidae are attached to submerged aquatic hosts, from which they obtain both nourishment and air supply. Numerous Carabidae and Staphylinidae live in gravel by the water's edge and are more or less constantly in contact with it.

The burrowing habit is well developed in Australian beetles, particularly those of the arid regions, which need to escape the rigours of the mid-day climate. Such beetles, which include many Carabidae and Tenebrionidae, generally emerge at night to feed. However, a few are completely blind and apparently spend their entire life-cycles within the soil; others are more or less restricted to caves but in our region, true troglobites are known only from Tasmania and these all belong to the Carabidae.

Although many beetles possess functional wings their flight activity is, in general, limited and unsustained. Some species appear to indulge in but a single crepuscular flight that takes place under suitable conditions of warmth and humidity and is associated with dispersal; others that depend upon unstable habitats, such as floodplains or forest clearings, or ephemeral food supplies, may fly more frequently but it is only the strong-flying Rose chafers (Scarabaeidae, Cetoniinae), Jewel Beetles (Buprestidae) and perhaps a few others that spend a significant fraction of their lifetime on the wing. Many species have lost their powers of flight altogether and their hind wings and/or the associated muscles have atrophied; others are known in which the wings are polymorphic and in these, only a proportion of the total individuals are able to fly and to found distant new colonies.

Although derived from functional fore wings in the past, the elytra now seldom play an active role in flight, except in the family Lycidae and perhaps a few others where these organs are still poorly differentiated. In these exceptional cases, the elytra are vibrated in unison with the hind wings but for the rest, they merely serve as planing surfaces that perhaps make some contribution to lift but none towards forward motion. Indeed, many beetles with strongly convex bodies and correspondingly curved elytra give every appearance of being hindered in flight by the drag these organs inevitably entail. In the Rose chafers, however, the problem has been overcome by reduction of the epipleurae, enabling deployment of the hind wings while the elytra remain closed: these beetles are exceptionally strong on the wing.

Feeding habits

The feeding habits of beetles are exceedingly diverse–a factor that has undoubtedly contributed to their remarkable success in the strugle for survival–but the majority depend upon vegetable matters of various kinds. In some families the larval feeding habits differ entirely from those of corresponding adults (e.g. Hydrophilidae, with predacious larvae and phytophagous adults) and in others, the adults do not feed at all (e.g. most Lucanidae, Lampyridae, Rhipiphoridae) but subsist on energy reserves carried over from the larval stages. Frequently, however, adults and larvae are found together, feeding upon the same materials.

Prominent among the plant-feeders are the Chrysomelidae, which consume the foliage (as their common name Leaf beetles implies) both as larvae and adults. Certain Coccinellidae and Curculionidae have similar habits but many of the latter attack the ripening seeds of a wide variety of plants. Fungi are eaten by some specifically adapted groups, notably the Scaphidiidae, Erotylidae and Endomychidae, together with certain Tenebrionidae, Anthicidae and Anthribidae. Woody tissue of living trees and shrubs is attacked by borers belonging to many different families but among which, perhaps, the Cerambycidae are most prominent. Others with this preference are the Buprestidae, Anobiidae, Bostrychidae, Lymexylidae and some Curculionidae. The sappy tissue under bark of wounded or dying trees is favoured by the very flattened Cucujidae.

Dead wood, that has already been partly broken down by the primary borers, but that is not badly infested with termites, provides the livelihood for many families, such as Tenebrionidae, Alleculidae, Lucanidae and Passalidae, whose members further the disintegration until little more than compost remains, when numerous chafers of the family Scarabaeidae complete the work. Larval Oedemeridae seem to specialise in saline driftwood, although some certainly develop in unimpregnated timber.

Numerous beetle scavengers are known and many are beneficial disposers of natural waste materials. Dung beetles of the family Scarabaeidae consume or bury as larval provisions great quantities of animal manure, thus contributing to the recycling of nutrients and Carrion beetles (Silphidae) do likewise with rotting carcasses. Both of these groups are rather poorly represented in Australia, where the restricted natural provision of their food materials, prior to the advent of European man and his domesticated animals, did not encourage their proliferation.

Many beetles live and breed in rotting vegetable matter, leaf litter, etc., but few consume the material directly: they mostly eat associated arthropods that are the primary feeders (e.g. many predatory Staphylinidae and Histeridae). However, chafer larvae of the scarabaeid subfamilies Melolonthinae, Dynastinae and particularly Cetoniinae are frequently humus-feeders. Scavengers of animal remains include the Dermestidae and Ptinidae, both of which have readily made the transition to stored products.

Among the land-dwelling predators, the Carabidae are mostly general hunters that will attack almost any soft-bodied creature that they can overcome, but adults of most species of one subfamily (the Harpalinae) are at least partly vegetarian. Staphylinidae and Histeridae are more specialised predators of fly-maggots and other insect larvae, whereas Cleridae attack wood-borers of various kinds. Most Coccinellidae prey upon sap-sucking bugs (aphids, scales and mealybugs) and mites.

The Dytiscidae are the most voracious of the aquatic carnivores, both as larvae and adults. Gyrinidae are also exclusively carnivorous but the adults attack mainly moribund (drowning) prey. Hydrophilidae are predaceous only in the larval stages.

Truly parasitic beetles that live at the expense of a host animal without killing it, as do lice and fleas, are few, but the small blind staphylinid *Myotyphlus jansoni* Matth. is sometimes found in the fur of native rats, where it apparently feeds on flakes of skin. Members of the non-Australian family Leptinidae have similar habits and are entirely confined to the nests and runs of rodents. A blood-sucking carabid larva that attacks toads is known from South Africa.

Some overseas Meloidae are parasites as larvae of social bees, and feed mainly on the stored provisions, but the habits of our few species are not known. Certain Rhipiphoridae are inquilines in the nests of social wasps, where they feed as larvae on part of the brood; others attack and eventually kill larval solitary wasps. One group of Australian species in this family are larval parasitoids of cockroaches. Numerous Staphylinidae, Histeridae and Ptinidae live as inquilines in the nests of ants or termites and every grade of status between marauding intruder and tolerated guest is to be found among them. Although such inquilines undoubtedly sap some of the vigour of their host's colonies, they seldom cause their total demise.

Reproduction and life histories

The majority of beetles reproduce themselves in the usual bisexual manner and cases of parthenogenesis are rather rare, although a few are known in the Curculionidae, Chrysomelidae, Dermestidae and Ptinidae. The meeting of the sexes most often occurs in the vicinity of the food, or on flowers, but in wide ranging predators such as Carabidae and Dytiscidae, it probably results from chance encounters. In some beetles the antennae of the male are more elaborate than those of the female and this is correlated with the emission by the female of a chemical sex attractant, which stimulates males to fly upwind in search of her. The reverse case of female attracted to male is much less frequent but is known in certain Bark beetles (Scolytinae). Flashing light signals form the basis of sex attraction in the Fireflies (Lampyridae) and in the most advanced species, are emitted by both sexes, to form something of a courtship pattern—a rare phenomenon among beetles.

Multiple mating is the rule with most beetles, where both sexes normally copulate several times during the course of their life span, but strict monogamy does occur in a few groups, notably among the dung-feeding Scarabaeidae, where males and females often collaborate in the preparation of the dung ball, within which the eggs are to be laid.

Adult beetles are seldom closely associated with their young, which in many cases develop after the death of their parents. The only provision normally made for the next generation is the choice, by the female, of a suitable site for egg laying. The careful preparation of the buried carcass by female Sexton beetles (*Nicrophorus*, a non-Australian genus of Silphidae), which appear to feed the young larvae directly, and the close association of adult and larval Passalidae, probably represent the pinnacle of subsociality in the Coleoptera. Certain female Carabidae (*Notonomus* and related genera) are also known to brood over caches of eggs or young larvae but the precise nature of this association is not yet clear. Presumably the larvae, which soon develop cannibalistic tendencies, disperse as soon as they are able to fend for themselves. However, there is some evidence to suggest that certain large carabids of the genus *Nurus*, which live in burrows, may actually maintain their larvae with masticated prey at least until the second instar.

The duration of the larval stages is very variable and is probably dependent upon the abundance and richness of the food supply. Many of the predators and others living on highly nutritious and abundant food complete their development in a few weeks. Wood borers, on the other hand, often show a very protracted larval period, owing to the poor quality of their diet. They are, however, very tenacious of life and frequently succeed in producing adults, albeit markedly undersized, under conditions of severe malnutrition. There are many cases on record of adult beetles emerging from furniture many years after its manufacture and in circumstances that leave no doubt but that the larvae were present in the original raw timber.

The North American Jewel beetle *Buprestis aurulenta* L. is sometimes imported into this country in this way and it has been known to spend more than 20 years in completing its life cycle in seasoned wood. Similar reports exist for several native species.

The pupal phase is always rather short but the callow adult may spend many months lying in its cell before emerging. The active adult life, in most beetles, is a matter of a few weeks and seldom extends beyond the season of emergence. However, the Green Caterpillar-hunter, *Calosoma schayeri* Er. (Carabidae) and related northern species, are known to overwinter as yearling adults and to mate and lay eggs early in their second summer. Some large Tenebrionidae from the northern hemisphere, such as the Cellar Beetle, *Blaps mucronata* L., in which the tempo of life is very slow, have lived in captivity for several years and to judge from their sluggish habits, our own amycterine Ground weevils might be expected to show greater than average longevity.

Defensive mechanisms

Escape by running and/or flying is the usual defensive mechanism with highly mobile beetles, such as the Tiger beetles (Carabidae, Cicindelinae) and some of the more active flower-visitors (e.g. Mordellidae) but the more lethargic and cryptic plant-feeders merely release their hold and drop to the ground, where they become almost impossible to find. Many Ground beetles (Carabidae) and Stag beetles (Lucanidae) stiffen and feign death; others, such as the Rove beetles (Staphylinidae), adopt threatening postures with the mandibles splayed and the tip of the abdomen, which carries the defensive vesicles, raised in a scorpion-like way. Click beetles (Elateridae) use their click mechanism repeatedly when seized and many Scarabaeidae, Cerambycidae and others stridulate loudly by rubbing one part of the body against another, thereby producing sudden sounds and vibrations as a 'surprise effect' that evidently persuades some predators momentarily to release their hold.

Many beetles rely upon chemical means for defence. Some, such as Lycidae, Oedemeridae, Meloidae and the well known Ladybirds (Coccinellidae) are apparently distasteful to most insectivores because of poisonous or acrid principles contained in their blood and they advertise themselves in bold (often red and black) colours that soon become recognised as 'warning colours' by would-be predators. Other species, in many families (notably Carabidae, Staphylinidae, Cerambycidae and Tenebrionidae) have special glands and associated reservoirs that produce and store poisons and repellents of various kinds. Larvae of Leaf beetles of the genus *Paropsis* have a pair of eversible vesicles on top of the abdomen, from which is exuded deadly cyanide, and many Longhorn beetles (Cerambycidae) have glands and orifices under the metathorax. Most Carabidae and Staphylinidae have pygidial glands that

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