

NOTES ON AUSTRALIAN *NEUROPTERA* AND THEIR LIFE-HISTORIES.

BY WALTER W. FROGGATT, F.L.S.

The Neuroptera treated of in this paper, with one exception (*Bittacus australis*), all belong to the Family *Hemerobiidae*. This has been subdivided into seven Subfamilies containing a number of very handsome lace-wings, of which the ant-lions are probably the best known. Although nearly fifty years have elapsed since most of the Australian species were described, little or nothing has been recorded about their habits or transformations; yet several species are common in the neighbourhood of Sydney, and the funnel-shaped pits of the larval ant-lions are common in any dry sheltered sandy place. I am not aware that anyone has kept the larvæ and bred the perfect insects so that the species could be determined.

All our known species have been described from dead, shrivelled, and sometimes very old and mutilated specimens, obtained from collectors without any definite habitats; and, as in the case of many of Walker's descriptions, in which colour and size are the chief characters given, when the living or freshly-captured insects are examined their characters do not agree always with those mentioned in the original descriptions.

Through the kindness of Dr. Sharp, of the Cambridge University Museum, to whom I submitted a number of typical Neuroptera for determination, and after a careful examination of the specimens in the Macleay Museum, in conjunction with the descriptions of Leach and Walker, I have been able to get my specimens identified and named.

During the last few years, while visiting the country districts on departmental work, I have had opportunities of collecting the larvæ of some of these insects and breeding out the imagines.

Accordingly, in addition to notes on life-histories, I have given brief descriptions of some of the species, with remarks on habitats and distribution.

BITTACUS AUSTRALIS, Klug.

Klug, Abh. Akad. Wiss. Berlin, 100, 11, 1836; *B. corethrarius*, Ramb., Hist. Nat. Ins. Néurop. 327, 1842.

This representative of a world-wide genus has an extensive range over Australia and Tasmania. It is very common in the neighbourhood of Sydney in early summer, frequenting *Leptospermum* and *Melaleuca* bushes when in bloom, to the foliage of which the insects cling by the two fore pairs of legs, letting the long hind ones hang loosely down behind ready to strike at any incautious insect that may come within kicking distance. In general appearance they closely resemble thickset crane flies or "daddy longlegs"; and apparently, by mimicking these harmless Diptera, they are enabled not only to catch them, but to beguile other helpless creatures within reach of their deadly hind legs.

General colour reddish-brown marked with black; wings narrow, fuscous, thickly covered with black nervures; stigma of the same colour near the tips. Head long, slender, and turned downwards in front, forming a regular beak furnished with two sharp jaws. Legs long, cylindrical, lightly clothed with hairs, and of a curious annular structure extending into the tarsi, the most remarkable point, however, being the form of the hind legs. Femora thickened like the hind leg of a grasshopper; the tibiæ long and slender, with two very long slender spines standing out at the extremity; tarsi composed of five large joints fringed on the undersurface with fine spines, the last joint curving round to a sharp point (taking the place of the tarsal claw); in the living insect the whole of the undersurface of the tarsi is covered with a sticky sponge-like process. When the tarsi touch an insect they curl round, the terminal claw closing over between the apical spines of the tibiæ.

I have frequently taken home specimens of *Bittacus* and enclosed them in a glass jar into which house flies were introduced.

These were very soon captured by the neuropters striking out with their hind legs; a fly enfolded on the sticky spiny tarsi was held in a vice-like grip, while the leg curled round under the head; and in a very short time it was sucked dry and dropped on the bottom of the jar.

F. Brauer has given an account of the insect-catching habit of the common European species (*Bittacus tipularius*, Fabr.).*

GLENURUS PULCHELLUS, Rambur.

Myrmeleon pulchellus, Ramb., Hist. Nat. Ins. Néurop. 408, 1842.

This is the commonest Australian species of ant-lion, and has a wide range over New South Wales and Queensland. The perfect insects are generally found resting on grass stalks or twigs in open forest country, with their wings folded down over the body. When disturbed they flit along with a very awkward motion as if the wings were too big for the body, so that they are very easily run down and captured.

Length of body 1 inch; expanse of wings $2\frac{1}{2}$ inches.

General colour chocolate-brown, mottled and marbled with light brown; face below the eyes, a line between them, under-surface of head, thorax, and base of abdomen yellow; antennæ dark reddish-brown, at the base and near the tip marked with dull orange. Legs light brown, mottled with black. Forewings semitransparent, thickly covered with a fine network of nervures, mottled and shaded with black, forming a distinct spot at the stigma; all the nervures clothed with little hairs, finest along the front margin; hindwings similar in form, with the apical portion deeply blotched with chestnut-brown, enclosing a double or confluent white spot, with another small spot at the tip.

The larva of this species is, I believe, the common ant-lion found forming funnel-shaped pits in sand under the shelter of

* Bauer, "Ueber die Lebensweise des *Bittacus tipularius*," Fabr., Verh. z.-b. Ver. in Wien, iii., 1853, p. 151.

logs, caves, &c., at the bottom of which it hides, and preys upon the ants that may fall into the pit-fall.

GLENURUS FALSUS, Walker.

Myrmeleon falsus, Walk., Brit. Mus. Cat. Neurop. 393, 1853.

This species was described from a specimen collected at Port Stephens, N.S.W. It is not so common as the former species, but specimens of it are to be found about Sydney in midsummer. It differs from *G. pulchellus* in having the parallel markings on the forewings much more defined and darker, and only one black irregularly rounded blotch near the tip of the hindwings. The general colour is also much darker without any yellow markings. In structure, size and form of wings there is very little difference, except that the wings are a little more slender and pointed at the tips.

GLENURUS ERYTHROCEPHALUS, Leach.

Myrmeleon erythrocephalus, Leach, Zool. Misc. i. 70, pl. xxx., 1814.

This distinctive lace-wing was also figured and briefly described in Griffith's 'Animal Kingdom' (Insects, ii. 1832, pl. 105, p. 327). I have a specimen collected at Grafton, Richmond River, that agrees with the wing-markings of this last figure; but Dr. David Sharp, Curator of the Cambridge Museum, to whom a duplicate specimen was forwarded, thinks it is a distinct species. I have examined several in the Macleay Museum, and find that the black spots and markings are very variable; in the hindwings of one specimen the wing on one side bears five spots and its fellow only three.

Length of body $1\frac{1}{4}$; expanse of wings $2\frac{1}{2}$ inches.

Head, prothorax, centre of meso- and metathorax and thighs rich reddish-orange; antennæ, tibiæ and tarsi black; eyes large, hemispherical, projecting on the sides, slate-grey; remainder of thorax and abdominal segments greyish-brown. Wings large, hyaline; forewings ornamented with three parallel rows of black spots, the first and second consisting of 9-10 and the third of two

blotches; hindwings with usually three spots towards the tip, but the markings are variable.

I have never taken this species alive, but I have specimens from Grafton, Newcastle and Sydney. It will probably require to be placed in another genus when the classification is worked up, as it differs from the typical *Glenurus*. Leach's type is said to be in the Macleay Museum Collection.

GLENURUS FUNDATUS, Walk.

Myrmeleon fundatus, Walk., Brit. Mus. Cat. Neurop. 320, 1853.

This is our largest species of ant-lion, measuring from an inch to half as long again in the body; and with an expanse of over four inches across the wings.

It has a very wide range over Australia; Walker records it from Port Curtis, Q., Western Australia, and Tasmania. Mr. Masters informs me that he has taken it about Sydney. I have specimens from Kalgoorlie, W.A., and a fine series obtained at Townsville, N.Q., was recently sent to me by Mr. F. A. Dodd.

General colour brown, thickly covered with greyish hairs, longest and densest upon thorax and legs; face, undersurface of prothorax, base of forelegs and wings yellow; antennæ grey. Wings hyaline; hindwings shortest but similar to forewings in markings, the nervures so finely marked with dark brown that they have a greyish tint.

GLENURUS CIRCUITER, Walk.

Myrmeleon circuiter, Walk., Brit. Mus. Cat. Neurop. 400.

This is one of the most distinctive Australian species on account of the rich chestnut-coloured blotches and spots forming a variegated pattern over the large hyaline wings, both pairs of which curve round at the apex in front, and are distinctly arcuate on the hind margin at the tips.

The species has a wide range. There are specimens in the Macleay Museum labelled Rockhampton, Q., and New South Wales. Mr. Masters informs me that he took it many years

ago in Sydney gardens. I have captured a specimen at Bathurst, N.S.W.

Length of body $1\frac{1}{4}$; expanse of wings $3\frac{1}{2}$ inches.

Head and prothorax ochreous, antennæ yellow, legs dull yellowish-brown; meso- and metathorax black; abdominal segments brown marked with yellow. The whole insect clothed with black hairs, thickest on the fangs and prothorax.

SUPHALASCA SABULOSA, Walk.

Ascalaphus sabulosus, Walk., Brit. Mus. Cat. Neurop. 427, 1853.

This insect was originally described from Adelaide, S.A. My specimens were obtained at Condobolin, N.S.W.

Length of body 1; expanse of wings 2 inches.

General colour dark brown, with face, legs, base of wings and marks on abdominal segments yellow; the whole insect thickly clothed with fine long greyish and brown hairs. Eyes large, rounded, light chestnut, mottled with black. Antennæ composed of 30 joints of equal length standing straight up above the head; very slender, with a hollowed spoon-shaped club at the apex. Wings of uniform length, transparent, with a clouded parallel stripe down the front margin.

Specimens of the larvæ of this lace-wing were found under the bark pulled off the trunk of a dead sheoak (*Casuarina*) at Condobolin, N.S.W., on the 9th of September. They were resting against the trunk, and did not move until touched. When placed in a box they rested against the side in a similar manner, with the head pointing upwards and the ventral surface flattened against the wall, apparently never moving in the day time; nor did they eat any flies or other live insects placed in the box. They remained in this state a few days over a month, when one pupated, forming the usual round, parchment-like cocoon, about $\frac{1}{2}$ inch in diameter, from which the insect emerged on the 9th January.

Larva.—Length of body $\frac{1}{2}$ inch, with the projecting jaws $\frac{1}{4}$ inch longer. General colour dark chocolate-brown, slightly mottled

with lighter brown, the whole of the dorsal surface clothed with fine, flattened, rosette-like tufts, with finer feather-like ones upon the ventral surface, and the outer margins of the thoracic and abdominal segments armed with spiny processes. Head deeply arcuate in centre, with the side at the base of each mandible swelling out and rounded to the back of the head, which is flattened on the summit and arcuate behind. Mandibles very large, curving round to the pointed extremities, with the outer edge of the basal portion clothed with spiny tubercles, the inner edges furnished with three stout spines, the anterior one largest, the spaces between them covered with short blunt spines. Eyes forming a rounded space containing six separate lenses covered with spiny tubercles. Prothorax forming a regular neck enclosed by the base of the head; dorsulum and mesonotum forming short narrow folds behind. Abdomen swelling out on sides, tapering at apex to a slender pointed tip. Legs long, stout, covered with fine spines; tarsi long, furnished with stout claws.

SUPHALASCA FLAVIPES, Leach.

Ascalaphus flavipes, Leach, Zool. Misc. i. 48, pl. xx.; Walk., Brit. Mus. Cat. Neurop, 420, 1853: *Bubo flavipes*, Ramb., Hist. Nat. Ins. Néurop. 357, 1842; *Suphalasca flavipes*, Lefebvre, Mag. Zool. 1842.

This insect is about the same size as the preceding species, but differs in having the head and thorax yellow marked with brown, and the thick tuft of hair clothing the front of the head black instead of grey, though below and above it is grey. The legs are bright yellow except the base of the thighs and the tarsi, which are black. The wings are marked with a bright yellow blotch that looks like a true stigma at the extremity of each wing, running into the termination of the parallel nervures.

Leach and Walker give the locality as New Holland. My specimens were taken at Bathurst, N.S.W., clinging to a slender branch of a scrub tree, with the wings folded down the back.

SUPHALASCA SUBTRAHENS, Walk.

Ascalaphus subtrahens, Walk., Brit. Mus. Cat. Neurop. 430, 1853.

This species is unknown to me. It is a darker-coloured species than *S. flavipes*. The type was described from Adelaide, S.A.

NYMPHES MYRMELIONIDES, Leach.

Zool. Misc. i. p. 102, pl. xlv. 1814.

This handsome insect has a wide range over New South Wales. I have specimens found in the neighbourhood of Sydney, Newcastle and Armidale; also in Southern Queensland. The type was in Mr. Alexander Macleay's Collection, and was recorded from Australia. Mr. McLachlan says there is a fine series in the British Museum.

Length of body 1; expanse of wings $3\frac{1}{2}$ inches.

General colour reddish-brown, abdomen darker; eyes grey; antennæ black, reddish at apex, composed of 72 short rounded joints covered with fine hairs. Wings large, with the extremity of each blotched with an elongate white mark enclosed with brown.

Larvæ were obtained at Armidale about the end of November, hiding among rubbish or clinging to overturned logs, so well coated with bits of dirt that only the front of the head and mandibles were exposed; until disturbed they remained perfectly motionless, but moved quickly when touched. In captivity they took no food, and after remaining for three weeks in a jar three of them pupated, forming typical, rounded, parchment-like, pupal cases. From the situation in which they were found they would probably feed upon wood ants.

Larva.—Length 8 lines; general colour brown, marked with darker parallel lines on the dorsal surface of the thorax. Head arcuate in front, rounded on the sides, with the hind margin forming two rounded lobes attached to the thorax by a slender neck. Jaws longer than head, shaped like a pair of calipers, with slender points and a sharp pointed thorn in the centre of

the inner edge, clothed with long fine hairs, shortest at extremities. Eyes small, composed of six rounded facets, projecting beside the base of the jaws. Antennæ standing out straight above eyes, consisting of a short cylindrical basal joint and a long filiform appendage. Thoracic neck finely granulated with little star-like spots; prothorax in front produced into two lobes projecting on either side of the head, together with the rest of the thorax forming a shield-shaped plate. Abdomen narrow at base, elongate-oval, with a short pointed tubercle standing out in centre of each segment. The whole of the dorsal surface clothed with fine downy hairs, longest on the sides, with a fringe of fine finger-like appendages, longest behind the head, shortest at the tip of the abdomen, each fringed with fine hairs so that they look like feathers. Ventral surface pale ochreous, flattened, clothed with fine hairs, thickest on the abdominal segment. Legs long, slender, hairy; tarsi stout, claws large.

PORISMUS STRIGATUS, Burm.

Osmylus strigatus, Burm., Handb. Ent. ii. 984; Ramb., Hist. Nat. Ins. Néurop. 415: *Chrysopa maculipennis*, White, Eyre's Travels, Vol. i. Appendix, p. 432, pl. iv., fig. 2.

This insect has a wide range over New South Wales and Queensland, and in the early summer is not uncommon in the neighbourhood of Sydney. I once took about two dozen at rest, like a number of moths, upon the trunk of a large white gum-tree.

Length of body $\frac{1}{2}$; expanse of wings $1\frac{1}{2}$ inches.

Head red; palpi and antennæ black, the latter composed of about 75 joints, the first broad and oblong, the others small, round and clothed with short spiny bristles; upper surface of thoracic and abdominal segments black; undersurface and legs brown, except the fore pair, which are yellow. Wings rich blackish-brown with bright metallic reflections; forewings mottled and barred with pale yellow forming a row of four transverse bars on the base, with smaller parallel lines, and several spots and two curved lines at the apex; hindwings with the basal half and extreme tip yellow.

PSYCHOPSIS MIMICA, Newman.

Newm., Entomologist, p. 415, 1840-2; *Hemerobius mimicus*, Walk., Brit. Mus. Cat. Neurop. p. 279.

This beautiful insect when at rest, with its wings drooped down on the sides of the short cylindrical body, the head tucked under and almost hidden from view by the long hairs springing from the front of the thorax, is wonderfully like some of the homopterous insects belonging to the genus *Flata*.

Length of body $\frac{3}{4}$; expanse of wings $2\frac{1}{2}$ inches.

General colour dull pale yellow, thickly clothed with buff-coloured hairs. Head short, turned down in front. Eyes large, dark green, ocelli in line between the eyes. Antennæ short, slender, composed of 35 short cylindrical joints clothed with fine hairs. Jaws large, reddish-brown. Wings large; forewings swelling out in front, rounded at the tips, somewhat arcuate behind; hindwings more slender at the base, but rounded at apex; both pairs of wings thickly covered with a network of fine nervures fringed with fine buff-brown or white hairs, so that the whole of the wing surface is covered with downy hairs, and thickly fringed on the outer margins. Forewings blotched with irregular red and brown spots, and delicate brown and black lines and wavy markings; hindwings with a single brown blotch in the centre.

Newman described the type, which is now in the British Museum, in three lines, but he gave a woodcut of the insect on the title-page of the volume. His specimen was received from Adelaide, S.A. Though not a common insect, it has a wide range over the eastern and southern portions of Australia.

In the middle of December a living female was sent to me by a correspondent at Muswellbrook, which while in transit laid three bright green oval eggs. These were placed in a glass jar, and three weeks later two hatched out and the larvæ were found crawling about trying to escape. When placed in a watch glass with some larval psyllids and aphides, they immediately seized these with their long slender mandibles and soon sucked them

dry, the fluid running up the hollow jaws being easily observable with a lens. In spite of every care both larvæ died within a few weeks.

The following description of the larva is based upon very immature material:—Head broad, oval, rounded behind; mandibles long, slender, curved inwards; palpi 3-jointed, long, slender, reaching to the middle of the mandibles. Antennæ springing out from centre of the head, composed of 11 slender irregular joints, with a bristle at apex. Eyes small, ocelli not apparent. Prothorax narrow, overlapping head; legs long, slender, with the tarsal claw long, furnished with a long white hair at base of tarsi. Dorsal surface covered with small brown tubercles and short white hairs, those upon the abdomen forming two transverse rows on each segment.

PSYCHOPSIS CÆLIVAGUS, Walk.

Hemerobius cælivagus, Walk., Brit. Mus. Cat. Neurop. 279, 1853.

This is a lighter-coloured species than the preceding, and smaller.

Length $3\frac{1}{2}$; expanse of wings 15 lines.

A number of specimens of a dull-coloured species are in the Macleay Museum, and these, Mr. Masters informs me, were at one time taken in the gardens about Sydney. They may be referable to this species.

PSYCHOPSIS INSOLENS, McLachl.

McLachlan, Journ. Ent. ii. 114, pl. vi., fig. 3, 1863.

This is a common species in Queensland; there are a number of specimens of it in the British Museum. The type is in the British Museum, and was collected by the late Mr. Diggles at Moreton Bay, Q. It is somewhat smaller than *P. mimica*, and differs from it in being much lighter-coloured, without the rich colouration and tints on the wings.

CHRYSOPA RAMBURII, Schneider.

This is the typical form of this extensive genus. It is found in the neighbourhood of Sydney, and, from an economic point of view, is one of our most useful insect friends, for wherever mealy bugs and other soft-bodied scale-insects appear in any quantity, the active little larvæ of the *Chrysopa* follow them up, covering themselves with bits of dirt and the remains of their food, so that they might easily be mistaken for mealy bugs were it not for their projecting jaws, long legs, and active habits. When full-grown they form the usual, rounded, parchment-like pupa-cases, which are attached to branches among the living mealy bugs.

The perfect insects are of a delicate green tint, with bright golden-tinted eyes, and delicate gauze-like wings. They often fly to light on summer nights, and if they alight upon the table produce a most disagreeable smell.

SOME RECORDS OF NEW SOUTH WALES MOSSES.

BY W. FORSYTH.

[TITLE].

CENSUS MUSCORUM AUSTRALIENSIIUM.

A CLASSIFIED CATALOGUE OF THE FRONDOSE MOSSES OF AUSTRALIA AND TASMANIA, COLLATED FROM AVAILABLE PUBLICATIONS AND HERBARIA RECORDS, BY THE REV. W. WALTER WATTS AND THOMAS WHITELEGGE, F.R.M.S.

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