

A REVISION OF THE FISSILABIOIDEA
(CORDULEGASTERIDAE, PETALIIDAE AND PETALURIDAE)

(ORDER ODONATA).

PART II.—PETALIIDAE AND PETALURIDAE

AND APPENDIX TO PART I.

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P R E F A C E.

The second part of this Revision has been long delayed, Part I having been published in the *Memoirs* in the year 1929. As stated in the preface of that publication, it was intended that the second and concluding part should be dealt with by Dr. R. J. Tillyard, but unfortunately his duties as Economic Entomologist to the Commonwealth of Australia have been so onerous as to altogether preclude his giving any attention to the work and so the duty of completing it has again devolved upon the present writer.

Fortunately at the time of dealing with the collection of the Cordulegasteridae in the Selysian collection, I took the opportunity of making copious notes also on the material dealing with the *Petaliidae* and *Petaluridae*, mainly with the idea of passing on these to Dr. Tillyard. This foresight has greatly helped me in the present work, indeed it would have been impossible to have attempted it without. I have also had the benefit of Dr. Tillyard's advice as well as gifts of literature and specimens from his own collections. I have also a number of notes and diagrams made by myself from specimens in the British and Paris Museums and the Maclachlan collections. Mr. E. B. Williamson has also assisted with the gift of specimens of *T. thoreyi*.

I have deemed it best to give a short appendix dealing with specimens and species described since Part I was written, although it is to be admitted that these descriptions for the greater part are of so poor a value as to be of little use for systematic purposes. Mention of them however will give the present situation of the specimens and habitat of the species, so that future students will know where to look for them and the work itself will be more complete.

All the text-figures have been executed by myself, those of the *Petaluridae* from rough sketches supplied by Dr. Tillyard; the wing photographs have again been executed by Mr. W. C. Davies of New Zealand and are of the high-water mark of photographic art.

The scheme of Part II follows that of Part I; modelled as before on the great work on the Libellulinae by the late Dr. Ris whose death we have now to mourn. I personally have to regret the loss of his valuable and unstinted advice so freely given in the writing of the initial work. The notation employed is that of Tillyard and for reference to this students must consult Part I. Species shown in enclosed brackets are not included in the Selysian collection.

Family PETALIIDAE.

Dragonflies of comparatively large size specialized in several important respects—the approximation of the discoidal triangles to the line of the arc in both fore and hind-wings, the presence of a row of opaque coloured spots along the costal margin of all wings, the eyes separated or meeting at a point only, and finally, in the female, a typically Aeschnine ovipositor.

Head robust, transversely elongate; labium as long as broad, the apex slightly cleft, lateral lobes very large, outer border rounded, inner a little oblique and with a short hook at apex; labrum broader than long, rounded at the sides; antennae situated far from the ocelli, with basal joint very short, scarcely visible, second joint very long, cylindrical; face flat or projecting, very broad and overlapping the genae and adjacent portion of eyes; frons elevated, as high as or higher than the occiput, the latter small, with straight posterior border.

Prothorax small, partially concealed by the head and thorax, the latter robust, usually finely but densely downy. Legs short, hind femora extending just beyond hinder border of thorax and furnished with two rows of short, evenly-sized, closely-set spines.

Wings moderately short, apices rather pointed, base of hind excavated in the male, rounded in the female, tornus markedly angulate in the male; reticulation close; hyaline in colour and marked along the costal border with a row of reddish brown opaque or ruby red semitranslucent spots from 5 to 7 in number; membrane small, narrow; pterostigma moderately long, narrow or but slightly dilated at the proximal half, braced but the brace usually situated beneath the pterostigma at a variable distance from its proximal end; discoidal triangles of nearly the same shape in fore and hind-wings, costal and distal sides subequal, the basal much shorter, 2 to 3-celled, situated but slightly distad the level of the arc; subtriangles entire or traversed, 2 to 3-celled in one species; supratrangles entire or traversed; discoidal field beginning with a row of 3 cells and continued as far as bridge as rows of 2-cells, of even width throughout or widely dilated at termen; node situated near the middle of wings; arc more or less angulated; *R_{iii}* undulated or not; median space entire; basal space traversed once; no incomplete basal antenodal nervures present; anal loop usually poorly defined; anal triangle very large, 4 to 7-celled; antenodal nervures moderately numerous, the first and fifth to eight the primaries.

Abdomen cylindrical, dilated at base and but slightly so at the terminal segments in the male, stouter and more evenly cylindrical in the female, longer than the wings in both sexes, segments 7 and 8 dilated in some species by short narrow laminate wings extending from the jugal suture to end of segments; segment 10 in female narrow and coated beneath with minute spines or enormously dilated into an orbicular hollowed plate.

Genitalia.—Male: oreillets present on segment 2 and usually of great size in the male, atrophied in the female. Genital parts inconspicuous in profile; lamina depressed, shallowly but deeply arched, anterior hamules narrow leaf-like structures directed inward, their apices dilated and nearly meeting, posterior hamules broad at base, narrowing to a cylindrical rod furnished with short stiff bristles at the apex. Female: ovipositor robust, extending to end of abdomen and furnished at apex with a pair of tactile stilets and beneath these a pair of stiff downwardly curved bristles.

Anal appendages but slightly variable in the genera and very similar in the species; superiors usually equal to segment 10, short, foliate, usually slightly twisted on their long

axis, ribbed longitudinally, blunt or pointed at apex; inferior about one-third longer, shaped as a broad trifold plate, the median lobe broad, rounded and projecting beyond the lateral ones which form robust upturned spines on each side of it.

Distribution.—Confined to Tasmania, S. E. Australia and the Andean slopes of S. America. As pointed out by Tillyard, this distribution suggests a common origin from Antarctica from which point emigration took place along three divergent lines corresponding to Hedley's theory on the former land connections of Antarctica.

Only eight species belonging to five genera are at present known and, of the former, one at least is extremely doubtful. It seems probable however that more species will be forthcoming when further collecting has been carried out in S. America, especially in Patagonia and S. Chile. The insects are palaeartic in nature, preferring wet and cold climates, and so are found in submontane and montane areas as the distance of their habitats from the South Pole increases. One specimen in the Selysian collection is labelled as from Peru, and if this is correct, it must have been taken at a great altitude, for *Archipetalia*, whose habitat is the most southern of all is only found at an altitude of about 4,000 ft. Most Chilean species have come from Valparaiso where the Andes in the hinterland rise to an altitude of 24,000 ft., but we are furnished with no data to tell us at what height they were taken at.

The general facies of the species bears a remarkable resemblance to that of species of *Allogaster*, especially in the long transverse head and separated eyes, but when we come to analyse the individual characters we are forced to the conclusion that they are more Aeschnine in affinity and this is borne out by the larval characters which are clearly Aeschnine. The Petalias may thus be considered of archaic Aeschnine stock with Petalurine affinities in the shape of the pointed wings of the male, the very narrow pterostigma and the separation of the eyes, all archaic characters; they may be derived from a common ancestor of the *Petaluridae*, *Cordulegasteridae* and the earliest *Aeschnidae*, of the last of which the *Petaliidae* appears to be a specialized side-branch from near the base of the family.

Key to Genera.

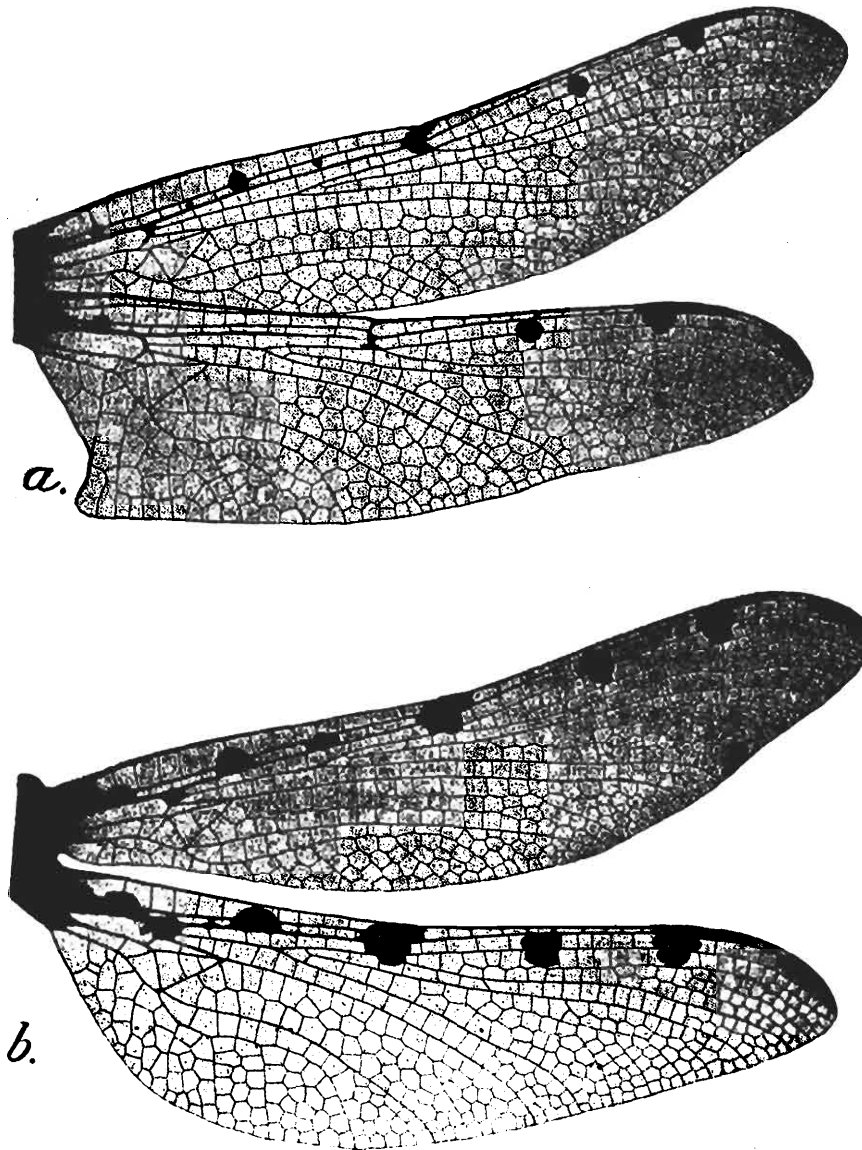
- | | | | | |
|---|---|--|----|--------------------------------|
| 1 | { | Eyes distinctly separated | .. | <i>Archipetalia</i> Tillyard. |
| | { | Eyes meeting for a short distance | 2 | |
| 2 | { | Discoidal triangles 3-celled; subtriangle of fore-wing 3-celled, 2-celled | | |
| | { | in the hind | .. | <i>Hypopetalia</i> MacLachlan. |
| | { | Discoidal triangles 2-celled; subtriangles single-celled | 3 | |
| 3 | { | Only 4 costal spots on wings; no apical spot; <i>Riii</i> not undulated; segment 10 in the female widely dilated as an orbicular excavated plate beneath | .. | <i>Petalia</i> Selys. |
| | { | More than 4 costal spots on wings; apical spot always present; <i>Riii</i> markedly undulated; segment 10 in the female narrow, not dilated | 4 | |
| 4 | { | Costal spots opaque reddish brown; habitat S. America | .. | <i>Phyllopetalia</i> Selys. |
| | { | Costal spots translucent ruby-red; habitat Australia | .. | <i>Austropetalia</i> Tillyard. |

The differences between *Phyllopetalia* and *Austropetalia* are so small as hardly to warrant their separation into two genera; it is mainly on account of their distribution that I have kept them separate; there are no venational differences, whatever.

[Genus **ARCHIPETALIA**, Tillyard (1917).]

Archipetalia, Tillyard, *Proc. Linn. Soc. N. S. Wales*, XLII, Part 3, p. 455 (1917).

The smallest insects of the group. Head Cordulegasterine in shape, narrow antero-posteriorly, elongate from side to side, eyes distinctly separated; occiput tumid behind, raised on dorsum, the dorsal ridge extending out along the posterior border of eyes for some distance and fringed with coarse white and black hairs; face broad, overlapping and concealing the genae; frons elevated, as high as the occiput, coarsely hairy above.



TEXT-FIG. 1.—Wings of *Archipetalia auriculata* Till. a. ♂. b. ♀.

Thorax short but robust, hairy; legs rather long, the hind femora extending to apical end of segment 1, and armed with two rows of short robust evenly-sized spines; tibial spines moderately long and robust.

Wings long, moderately narrow, very pointed at apices in the male, more rounded in the female, reticulation very close, excavate at base in the male, rounded in the female, tornus markedly angulate in the male; hyaline, marked with a row of 7 to 9 dark brown opaque costal spots as follows—a spot at the apex of wings, one at the pterostigma, one

midway between this organ and the node, one at the node and four spots between node and base of wing, one of which lies on the arc, two at the base sometimes confluent to form a basal streak, all these spots more extensive and sometimes partly confluent in the female; pterostigma long, very narrow, only slightly dilated at its proximal end, covering $2\frac{1}{2}$ to 3 cells, a well-formed brace which however is situated some distance distad its proximal end or near the middle of pterostigma; discoidal triangle only slightly distad the level of arc, rather more so in the hind than in the fore-wing, shaped similarly in the fore- and hind-wings, costal and distal sides subequal and considerably longer than the basal, formed of 2 cells; subtriangles one-celled in all wings; discoidal field 2-cells deep to well beyond the proximal end of bridge, of fairly even width throughout but definitely expanded at the border of the wing especially in the fore; 1 cubital nervure in all wings; anal triangle 4-celled; anal loop obsolete; supratrangles entire or traversed once in forewings, with one traversing nervure in the hind; *IA* pectinate in all wings; *Cu* in the forewing very flat and straight; arc moderately angulated; no basal incomplete basal antenodal nervures present; membrane very narrow and short; *Rspl* weakly formed; *Riii* and *Riv+v* markedly undulated.

Abdomen long, slim, cylindrical, but slightly dilated at the base in the male, more so in the female, scarcely constricted at segment 3; oreillets on segment 2 very large in the male, considerably smaller in the female; segments 7 and 8 without any vestiges of wing-like prolongations at the tergal margins; segment 10 in the female narrow and rounded beneath, without the conspicuous flat plate found in the *Petalia*s. Anal appendages: superiors about as long as segment 10, simple, broad at base, tapering rapidly to a finely pointed apex; inferior slightly longer than superiors, shaped as a broad, trifid plate, the apical portion quadrate, the lateral forming a robust spine on either side directed slightly backward, upward and outward.

Genitalia: genital fossa rather widely open anteriorly, narrowing posteriorly; anterior hamules flattened, leaflike structures turned in to meet across the genital fossa, apices rounded; posterior hamules broad at base, tapering to an obtuse point which is beset with several stiff bristles; lobe shaped like a jug with a deeply cleft narrow spout, rather broad and rounded below; vulvar scales robust, Aeschnine in shape and character, furnished below and behind with a pair of tactile filaments and a pair of stiff downwardly curled bristles lying within these.

Genotype.—*Archipetalia auriculata* Tillyard.

Distribution.—Known only from Tasmania, the sole species known being found on streams flowing through swamps and marshes at the foot of and on the slopes of Cradle Mountain. The genus is the most archaic of the group *Petalia*, the Cordulegasterine shaped head with the eyes definitely separated, the very long, narrow pterostigma, the pointed wings of the male and the very large oreillets are all archaic characters, some Petalurine in character. The larva is unknown but probably closely resembles that of the following genus *Austropetalia*.

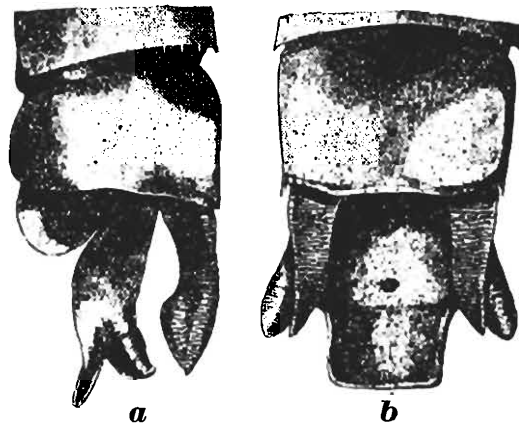
[***Archipetalia auriculata*** Tillyard (1917).]

Archipetalia auriculata, Tillyard, *Proc. Linn. Soc. N. S. Wales*, XLII, Part 3, pp. 450-452 and 454-455 (1917).

Coll. Tillyard, 10 ♂, 3 ♀, Type and allotype amongst these; coll. Fraser, 1 ♂, all from Cradle Mt., N. E. Tasmania.

Male.—Abdomen 41 mm. Hind-wing 31-32 mm.

Head.—labium dark reddish brown ; labrum reddish brown with the central portion yellow or with two small central yellow spots ; anteclypeus blackish brown ; postclypeus bright citron yellow save for the lower angulated prolongations which are dark brown, the yellow forming a broad stripe which extends from eye to eye ; frons brown at base above and broadly so in front, the crest with a broad citron yellow band extending along its whole length and enclosing by an angulation backwards, the basal brown ; eyes dark brown, broadly yellow beneath ; vertex black ; occiput raised into a conical point, brownish yellow in front, bright citron yellow behind.



TEXT-FIG. 2.—Anal appendages of *Archipetalia auriculata* Till, ♂. a. Left lateral view. b. Dorsal view.

Prothorax dark reddish brown, marked with two small dorsal yellow spots. Thorax blackish brown marked with creamy yellow as follows—oblique antehumeral stripes pointed above and below, converging above towards the middorsal carina, diverging below where they broaden out considerably, a small upper humeral spot, two rather narrow oblique lateral stripes, the anterior of which lies on the mesepimeron and is followed below by a rounded spot just above the mesocoxa, the posterior on the metepimeron. Between these two stripes, 3 widely separated spots, the upper and lower ones yellow, the median obscurely greenish white. Legs black, femora dark reddish brown.

Wings hyaline palely enfumed, marked along the costa with a chain of opaque brownish spots as follows—a short ray or streak at the base, a small spot on the 1st antenodal nervure in the subcostal space which may be confluent with the preceding, a small spot on the arc, a larger one on the distal primary antenodal nervure and a similar one halfway between this and the node which however is only present in the fore-wings, a broad quadrate patch on the node, another rounded spot halfway between the node and pterostigma, a round spot on the brace below the pterostigma and lastly an elongate spot at the extreme apices of wings. Membrane white, narrow, confined to the petiole of wings ; anal triangle very large, constantly 4-celled, one nervure traversing it at its apex and three others converging to meet centrally above ; pterostigma 3 mm. long, dark reddish brown, bordered anteriorly by reddish brown and posteriorly by a thick black nervure covering 2 to 3-cells ; supratrangles traversed once in all wings but occasionally entire in the fore-wings ; nodal index $\frac{10-12}{8-10} \mid \frac{12-10}{10-9}$, $\frac{10-13}{9-11} \mid \frac{15-10}{10-11}$.

Abdomen narrow, cylindrical, without winglike prolongations at the tergal margins of segments 7 and 8 ; oreillets very large, minutely denticulate behind. Blackish brown

marked with greenish yellow as follows—segment 1 with an oblique narrow subdorsal stripe and a basoventral citron yellow spot; segment 2 with the oreillets bright yellow above and outwardly, bordered with blackish brown behind and beneath, a pair of dorsal spots bordering the jugal suture apicad, a pair of apicodorsal spots and a larger brighter ventroapical spot on each side; segments 3 to 6 with elongate basoventral spots on each side, an elongate triangular shaped spot on each side the middorsal carina with the base of the triangle resting on the jugal suture and its apex extending nearly to base of segment, a small triangular spot on the apical side of the jugal suture lying just external to the previous spots, and lastly a pair of elongate spots at the apex of each segment lying in the same line as the last mentioned spots; segments 7 and 8 similarly marked but the basal spots shortened and the apical lengthened due to the shifting of the jugal suture nearer the base of segments; the ventrolateral spots also longer and overlapping the jugal suture; segment 9 with the basal spots missing, the apical much larger and extending nearly to base of segment; segment 10 with a pair of irregularly quadrate dorsal spots extending outwards on each side.

Anal appendages; superiors black, as long as segment 10, unguulate, simple, broad at base, tapering to a fine point as seen from the dorsum, depressed and twisted inwardly on their long axis, broadening like the blade of a kukri and ending in a minute point as seen in profile; inferior slightly longer than superiors, a broad trifid plate, the middle lobe yellow, its apical border broadly dark reddish brown with a median point of the same colour in the yellow area, broad and squarely rounded at apex, along the border of which are some minute teeth; the lateral lobes very robust, thick spines directed backwards, upwards and outwards, the apex ending in a minute curled up point.

Female.—Abdomen 36 mm. Hind-wing 33 mm.

Very similar to the male but differing as follows—the wings broader and rounded at the tornus, the apex more rounded, the costal chain of coloured spots much more extensive and some spots more or less confluent; the yellow markings on the head more restricted, especially on the frons; abdomen shorter and stouter, more dilated at the base; segment 10 rounded and narrow beneath. Vulvar scales robust not extending to end of abdomen however, armed with two tactile stilets between which are two strong downwardly curved bristles; anal appendages black, short, conical, converging and sloping downwards.

Distribution.—Known only from Tasmania. Eleven males and three females from the slopes of Cradle Mt., N. E. Tasmania, from 3,000 to 4,000 ft., January. Dr. Tillyard secured these over small rivulets running through marshes, apparently similar to spots favoured by *Cordulegaster annulatus*. Others were seen flying up the slopes of the mountain. The separated eyes will distinguish it from other species of the group.

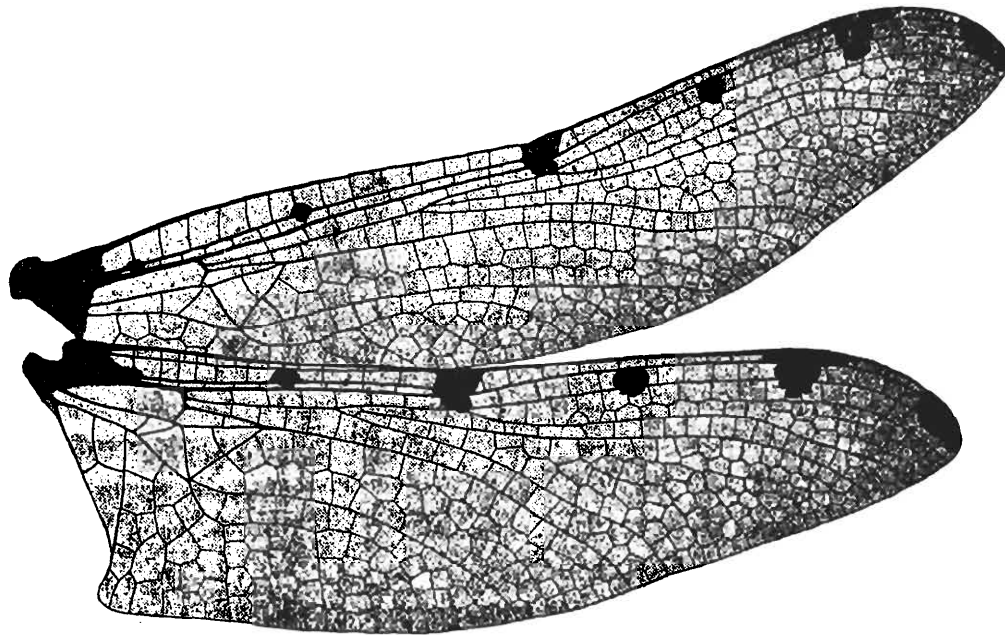
Genus **AUSTROPETALIA** Tillyard (1916).

Austropetalia, Tillyard, *Journ. Linn. Soc. (Zool.)*, XXXIII, pp. 13-15 (1916); *Id., Proc. Linn. Soc. N. S. Wales*, XLII, Part 3, p. 454 (1917).

Head Cordulegasterine in shape, narrow from before back and elongate from side to side, eyes just meeting at a point; occiput elevated, longitudinally ridged, arched at the posterior border and densely fringed with coarse long black hairs, which fringe is continued laterally for some distance along the posterior border of eyes; face very broad, overlapping and

obscuring the genae on each side ; frons elevated, rather higher than the occiput and fringed with long coarse black hairs.

Thorax short but robust ; legs moderately short ; hind femora not extending to apical end of segment 1 and armed with two rows of short robust evenly sized spines ; tibial spines moderately short and stout.



TEXT-FIG. 3.—Wings of *Austropetalia patricia* (Till) ♂.

Wings rather long and narrow, reticulation close, hyaline, but marked with a row of six or seven blood-red translucent costal spots, each spot edged with blackish brown,—one spot at apex, one at the pterostigma, one between node and pterostigma, one at the node, two spots between the node and base of wing (one only in the hind-wing), and lastly a basal spot or streak ; these spots much larger in the female and sometimes more or less confluent ; pterostigma narrow and elongate, slightly dilated at the middle, covering $1\frac{1}{2}$ to 2 cells, a well-developed brace situated slightly proximal to the middle of pterostigma ; discoidal triangle only very slightly distad the line of arc in all wings, that of the fore-wing with costal and distal sides equal and more than half as long again as the basal, made up of 2 cells ; that of hind-wing very similar in shape but with distal side slightly longer than the costal and made up of 2 or 3 cells ; subtriangles single-celled in all wings ; discoidal field 2 cells deep to beyond the proximal end of bridge, of fairly even width as far as border of wing ; 1 cubital nervure in all wings ; median space entire ; anal triangle 3-celled ; anal loop vestigial, made up of 3 to 4 cells ; supratrangles traversed once or exceptionally twice in the hind-wings ; *IA* pectinate in both fore- and hind-wings ; *Cu₁* in the fore-wing very flat and slightly sinuous ; arc markedly angulated ; no basal incomplete antenodal nervure present ; membrane very short and narrow ; base of hind-wing excavated in the male, rounded in the female, the tornus markedly angulate in the male ; *Rspl* well-formed ; *R₁* and *R₁+v* markedly undulated.

Abdomen long, slim, cylindrical, a little dilated at base, a little constricted at segment 3 ; oreillets on segment 2 very large in the male, much smaller in the female ; segments 7 and 8 without any vestiges of winglike lateral prolongations at the tergal margins ; segment

10 in the female without the broad quadrate plate found in *Petalia*, narrow and rounded below. Anal appendages: superiors simple, unguulate, subacute at apex, slightly longer than segment 10; inferior much longer, a broad trifold plate slightly hollowed out above, its apex broad and quadrate, its edges raised and ending on either side in a long very robust upwardly directed spine, closely resembling the inferior appendage found in some species of *Idionyx*.

Genitalia: genital fossa widely open anteriorly, narrowed posteriorly; anterior hamules petiolated, leaflike structures curled inwards; posterior hamules broad at base, unguulate thereafter and furnished at apex with a few stiff hairs or bristles; lobe short, rounded, jug-like in shape with the spout deeply cleft; penis ending in two long filaments. Vulvar scales robust, Aeschnine in shape and character, not extending to end of abdomen, furnished below with two tactile stylets and between these, two stiff downwardly directed bristles.

Genotype.—*Austropetalia patricia* (Tillyard).

Distribution.—From the Blue Mountains, Australia at altitudes of 3,000 to 4,000 ft. Only one species known at the present time. The apposition of the eyes, the more open reticulation and the slightly dilated character of the pterostigma point to the genus being more modern than the last.

[***Austropetalia patricia*** (Tillyard) (1906).]

Petalia apollo, Tillyard, *Proc. Linn. Soc. N. S. Wales*, XXXI, Part 4, pp. 722-724 (1906).

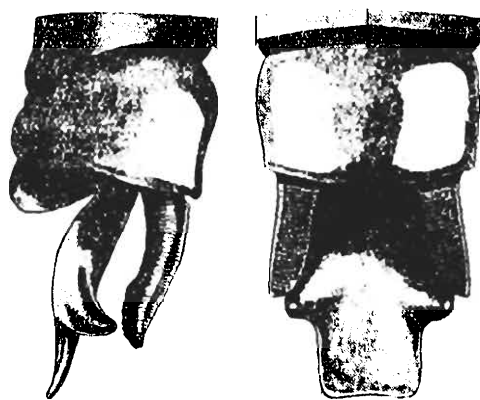
Phyllopetalia patricia, Tillyard, *Proc. Linn. Soc. N. S. Wales*, XXXIV, Part 4, pp. 677-708, Pl. lv, fig. 1-3 (1909).

Austropetalia patricia, Tillyard, *Journ. Linn. Soc. (Zool.)*, XXXIII, pp. 16-19 (1916).

Coll. Tillyard, several of both sexes, Type and allotype amongst these; coll. Froggart 1 ♀; coll. Br. Mus. 1 ♀; coll. F. C. Fraser 1 ♂. All from Leura and Katomba, 2,000-4,000 ft., Blue Mts., Australia.

Male.—Abdomen 50 mm. Hindwing 34 mm.

Head.—Labium dull brown, hairy; labrum reddish brown bordered broadly with citron yellow; anteclypeus black; postclypeus bright citron yellow, this forming a broad bar across the face from eye to eye, the upper border very narrowly and the angular prolongations below dark reddish brown; frons dark brown with the crest at the outer thirds finely citron yellow, heavily fringed with long black hairs; vertex and occiput black, the latter also heavily fringed with long coarse black hairs; eyes dark brown rimmed narrowly with yellow beneath.



TEXT-FIG. 4.—Anal appendages of *Austropetalia patricia* (Till) ♂. *a*. Left lateral view. *b*. Dorsal view.

Prothorax and thorax dark reddish brown, the latter marked with greenish yellow as follows—a narrow antehumeral stripe on each side the middorsal carina, lying about midway between it and the humeral suture and slightly divergent below ; laterally a pair of oblique slightly broader stripes edged with darker brown than the rest of the ground-colour, one situated on the mesepimeron, the other on the middle of the metepimeron, a minute spot on the lower posterior corners of thorax and lastly a larger spot close to the mesocoxa in continuation with but slightly separated from the antero-lateral stripe. Beneath paler brown, hairy. Legs black, but femora reddish brown beneath.

Wings hyaline marked along the costal margin with the following translucent blood-red spots, each encircled with dark brown or black—a basal spot, 3 mm. long, extending up to or a little beyond the 1st antenodal nervure in the costal space, a small spot on the subcostal nervure halfway to node, a larger spot bordering the node on its distal side, broadening towards the costa, a smaller spot on *R* lying halfway between the node and pterostigma, a larger spot below the proximal half of pterostigma, broadening at the latter, and lastly a triangular flattened spot at the apex of wings. In addition to these an occasional small spot on the subcosta halfway between the node and the larger subcostal spot. Venation that of the genus ; nodal index $\begin{array}{c} 13-14 \\ 9-10 \end{array} \mid \begin{array}{c} 10-11 \\ 9-10 \end{array} , \begin{array}{c} 11-13 \\ 9-8 \end{array} \mid \begin{array}{c} 13-10 \\ 9-8 \end{array}$; pterostigma forewing 2.8 mm., hindwing 3.4 mm. very narrow, covering $1\frac{1}{2}$ to 2 cells, deep opaque or semi-opaque blood-red between black nervures ; anal triangle constantly 3-celled.

Abdomen narrow, cylindrical and without winglike prolongations to the tergal margins of segments 7 and 8, basal segments but slightly tumid ; oreillets minutely denticulate posteriorly. Dark reddish brown marked with pea-green as follows—segment 1 unmarked ; segment 2 with a narrow short stripe lying parallel to the middorsal carina but well to each side of it and extending from base to jugal suture, a slightly broader stripe placed more outwardly and running from the jugal suture in a curved manner towards the apical end of middorsal carina but broadly broken or interrupted at its middle, the oreillets broadly green on the dorsum ; segments 3 to 7 with a pair of narrow dorsal stripes extending from the base of each segment to the jugal suture, slightly divergent near the base of segments and a pair of large subdorsal spots situated on the apical side of the jugal sutures which they touch, lastly a larger bright citron yellow spot on each side near the base and ventral border of the tergites ; segment 8 with similar stripes and spots but the postjugal spots extending to apical border of segment and the ventral spot extending a little beyond the jugal suture ; segment 9 with the ventral spots and a pair of dorsal stripes extending the whole length of segment ; segment 10 with a pair of broad rectangular dorsal spots well separated on the middorsum and with a pair of tiny spots between their bases, the larger spots extending to apex of segment but not quite to the base.

Anal appendages : superiors 1.2 mm. long, about equal to the length of segment 10, straight, depressed very slightly divergent at apices which are slightly bevelled from within out and obtusely pointed at apex without ; inferior nearly twice the length of superiors, broad, trifold, the central part a broad quadrate plate projecting far beyond the lateral parts, a little convex above and broadly and shallowly emarginate at the apical border ; lateral parts forming robust, thick spines, curling strongly upwards to meet the apices of superiors.

Female.—Abdomen 42 mm. Hindwing 39 mm.

Closely similar to the male, differing in the following points—abdomen stouter, shorter and cylindrical throughout; costal spots on wings very much larger and occasionally confluent, the distal subcostal spot always present in forewings, the basal spot receding from costa and extending to the 4th antenodal nervure. The 5th antenodal nervure in the forewings, and the 5th to 8th in the hind clouded with crimson, the pterostigmal spot almost as long as that organ. The abdominal markings broader; on segment 8 the basodorsal markings reduced to small round spots, a pair of basolateral spots and a pair of divergent apicodorsal spots; segment 9 with a pair of elongate dorsal spots, whilst the spots of segment 10 are smaller. Segments 8 and 9 have vestigial lateral prolongations, the tergal wing on segment 9 being edged with green. Vulvar scales robust, thick, dark red, Aeschnine in shape. Anal appendages very short, set widely apart, black, slightly convergent and sloping downwards, obtusely pointed.

Distribution.—Blue Mts., Australia. The species is a rare one, few records being available of its capture. Its larva has been described by Dr. Tillyard and shows very definite Aeschnine characters. It breeds in swift mountain streams in the neighbourhood of cascades; its abdomen is markedly tuberculated and spined forming robust imbrications which probably serve to anchor it firmly to rocks against the swift currents in which it lives.

Genus **PETALIA** Selys-Hagen (1854).

Insects of moderate size. Head narrowed antero-posteriorly, elongate from side to side, eyes meeting at a point only; occiput small, a little tumid behind, ridged above where it is fringed with coarse hairs; face very broad, overlapping and concealing the genae, and also the adjacent portion of eyes; frons very high, rather more so than occiput, arched strongly and shallowly emarginate at its crest.

Thorax short but robust, coated with downy hair; legs short, hind femora not extending beyond base of segment 2 of abdomen, and armed with two rows of closely-set, evenly sized, short spines; tibial spines moderately long and robust.

Wings moderately short and moderately pointed at apices, reticulation close, base of hindwings excavate in the male, rounded in the female, tornus markedly angulate in the male. All wings marked with a row of 4 reddish brown costal spots disposed as follows—an elongate basal spot, one between the base and node, one at the node and a fourth below the pterostigma, which latter may be divided into two. *No apical spot.* Pterostigma narrow, of moderate length, braced but this arising a little distad the proximal end of pterostigma, covering about 3 cells; discoidal cell lying slightly distad the level of arc, shaped rather similarly in fore- and hind-wings, costal and distal sides subequal, the distal side slightly longer than costal and both considerably longer than the basal, made up of 2 cells in both fore- and hind-wings; subtriangles equilateral, entire, similar in shape in the wings; discoidal field beginning with a row of 3 cells and continued as rows of 2 cells to a little distad the proximal end of Bridge, only slightly dilated at margin of forewing; 2 cubital nervures in all wings; anal triangle made up of 3 cells; anal loop absent; supratrangles traversed once in forewings, entire in the hind; arc but slightly angulated; *IA* pectinate in all wings, especially in the fore; *Riii* and *Riv+v* not undulated; *Cvii* in forewings flat and

broadly archèd ; no basal incomplete antenodal present ; membrane elongate ; *Rspl* but weakly formed ; anal field 2 rows deep in forewing, 5 to 6 in the hind.

Abdomen long and slim, cylindrical, dilated at base, slightly constricted at segment 3, tapering gradually to the end ; oreillets on segment 2 small but prominent, rudimentary in the female, segments 7 and 8 without wing-like dilatations at the tergal margins. Anal appendages : superiors rather longer than segment 10, with a strong median rib, dilated and spatulate at apex, curved towards each other as seen from above, broad at basal half, flattened and contracted at apical half as seen in profile ; inferior a short trifold plate of about half the length of the superiors, the median lobe but slightly longer than the lateral which are short thick robust spines directed somewhat upwards and outwards. In the female the lower and outer borders of segment 10 enormously dilated to form an orbicular plate about 6 mm. in length by 4 mm. breadth. Anal appendages of about the same length, conical, slender, sloping downwards ; vulvar scales very robust, Aeschnine in shape but longer than usual in that genus. Genitalia of male closely similar to that of *A. patricia*.

Genotype.—*Petalia punctata* Hagen.

Distribution.—Known only from Chile. The genus is distinguished from others by the wings with only 4 costal coloured spots, by the non-undulated character of *Riii* and by the enormously dilated plate found beneath segment 10 of the female.

Petalia punctata Hagen.

Petalia punctata, Selys-Hagen, *Bull. Acad. Roy. Belg.* (2) XXI, p. 107 (1854) ; *Id.*, (2) XXVIII, p. 204 (1869) ; *Id.*, *Mon. Gomph.* p. 353 (1857) ; Kirby, *cat. Odon.* p. 82 (1890).

Coll. Hagen, 1 ♂, Chile ; coll. Mus. Leyden, 1 ♀, Chile.

Male.—Abdomen 46 mm. Hindwing 35 mm.

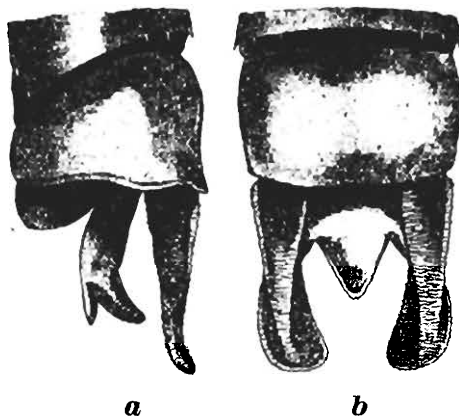
Head.—Labium with the lateral lobes shorter than in the following genus-*Phyllopetalia*, ochreous, coated with downy greyish hair ; labrum brownish with a large median basal black point ; anteclypeus dark brown, postclypeus pale brown traversed by a broad yellow stripe above made up of six spots, a germinate spot at the middle, one on each side in front and a second on each side only visible from the side against the eyes ; frons brownish yellow in front, blackish brown above with a large oval yellow spot on each side of the median notch and another on each side against the eyes ; vertex black ; occiput reddish brown, forming a thin crest separating the eyes above and in front, a little tumid behind where it bears a fringe of reddish brown hairs, this continued outwardly along the upper borders of eyes ; eyes brown, reddish brown behind narrowly bordered with yellow above.

Prothorax dark brown, coated with short hairs. Thorax heavily coated with fine short greyish hairs, black marked with pale green as follows ;—A moderately broad cuneiform antehumeral stripe pointed below, rounded above, not quite meeting the antealar sinus, two straight equally narrow stripes on each side with a small upper oval spot lying between them, some spots on the tergum ; beneath thorax ochreous.

Wings hyaline marked with 4 costal reddish brown spots as follows ;—A small streak at the base which may be united to a small rounded spot lying on the basal antenodal nervure, the basal spot extending along the base of wing from costa to hinder border ; a rounded spot between the base and node ; a larger more quadrate spot at the node ; finally one at the proximal end of pterostigma narrowly united by the latter to a very small spot near the

distal end of that organ; membrane well developed, white; pterostigma yellow at its middle, brown at either end and framed in black nervures, covering $3\frac{1}{2}$ cells; nodal index

10-15	15-10
10-10	10-10



TEXT-FIG. 5.—Anal appendages of *Petalia punctata* Selys. ♂. a. Left lateral view. b. Dorsal view.

Abdomen blackish brown marked with green as follows;—A dorsal and a lateral spot on segment 1; a pair of rounded spots on segment 2 well separated by the middorsal carina, lying on the apical side of the jugal suture and occupying about the middle third of the segment, the upper lateral surface of the oreillets which bear some small black spines behind, and a small latero-apical spot on each side; segments 3 to 7 with the paired jugal spots on dorsum and a basal and median elongate spot on each side; segment 8 with the dorsal spots lying nearer the base owing to the situation of the jugum, and more widely separated by the middorsal crest; segment 9 with a pair of basal spots, segment 10 with its apical border greenish yellow bordered finely with black. The dorsal paired spots framed in black, as also all the inter-segmental joints.

Anal appendages: superiors black, slightly longer than segment 10, thickened at base and strongly ribbed above, the apex again dilated especially within. Seen from above these appendages curved in gradually and regularly towards each other, whilst from the side they are seen to slope downwards, the apex turned up slightly and truncate; inferior only half the length of superiors, reddish yellow, trifid at apex, the lateral portions robust, upwardly and backwardly directed spines, the median lobe a broad triangular pointed plate but slightly longer than the lateral spines.

Legs black, the femora reddish brown except at the distal ends; tibiae and tarsi black.

Female.—Abdomen 42 mm. Hindwing 38 mm.

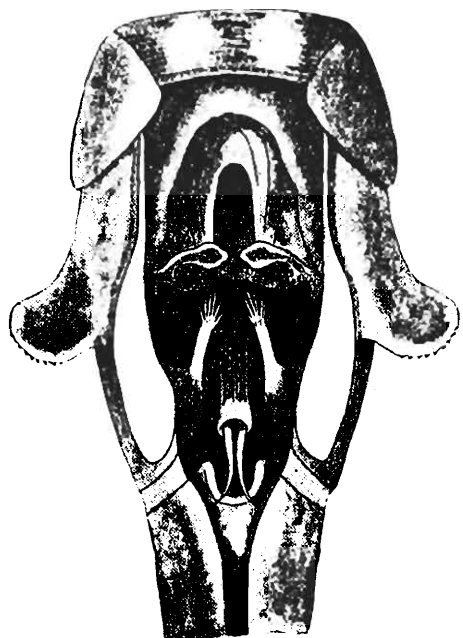
Closely similar to the male, differing only by the green markings broader in extent, the costal coloured spots larger, the abdomen shorter, stouter, more cylindrical, not constricted at segment 3, and lastly by the broad orbicular excavated plate beneath segment 10.

Distribution.—Ouchacay, Chile. Differs from other species of the group by the wings which have only 4 costal coloured spots, by the non-undulated character of *R*s and by the broad genital plate on segment 10 of the female.

Genus **PHYLLOPETALIA** Selys (1857).

Phyllopetalia, Selys, *Mon. Gomp.* p. 356 (1857); *Id.*, *Bull. Acad. Roy. Belg.* (2) VII, p. 549 (1859); Kirby, *Cat. Odon.* p. 82 (1890).

Medium sized insects very similar in characters to the last genus. Head Cordulegasterine in shape, narrowed antero-posteriorly, elongate from side to side, eyes meeting at a point only; occiput small, slightly tumid behind, arched above and with a thin ridge extending forwards to the junction of the eyes, fringed with long black hairs behind, this fringe extending for some distance along the posterior border of eyes; face broad, overlapping the genae and to some extent the inner border of eyes; frons elevated as high or higher than the occiput, as deep or twice as deep as the clypeus, broad or markedly conical in the species, *not notched above*.



TEXT-FIG. 6.—Genitalia of *Phyllopetalia apicalis* Selys, ♂.

Thorax robust, finely but densely hairy; legs of moderate length, femora slim, armed with two rows of closely-set, evenly-sized short spines; tibial spines numerous, of moderate length and rather thick.

Wings moderately long and broad, apices subacute, reticulation close or moderately so, base excavate in the male, rounded in the female, tornus markedly angulate in the male; hyaline marked with a row of five or six opaque reddish brown costal spots on all wings as follows;—A basal streak, one between this and the node, one at the node, a fourth at the proximal end of pterostigma and a fifth situated at the apex of each wing, all these spots larger in the female; pterostigma long and very narrow, longer in the hindwings, strongly braced but this brace situated a little distad the proximal end, its position variable in the species; discoidal triangle slightly distad the level of the arc, of very similar shape in fore and hind-wings, costal and distal sides subequal but the distal angulated or sinuous, both these sides much longer than the basal, the triangles invariably formed of 2 cells by a nervure which runs from the costal to the distal side; subtriangles one-celled in all wings; discoidal field beginning with a row of 2 or 3 cells and then continued as rows of 2 cells to well beyond proximal end of bridge, of even width throughout and not dilated at the termen; 1 cubital nervure in all wings; anal triangle 3 to 5-celled; anal loop absent; supratrangles entire or more often traversed once; *IA* pectinate in all wings; *Cu₁* in forewings very flat and broadly arched; arc well angulated; no basal incomplete antenodal nervures present;

membrane short, almost obsolete; *Rspl* weakly formed; *Riii* and *Riv+v* markedly undulated.

Abdomen long and slim, tumid at base and again towards the anal end in the male, scarcely constricted at segment 3, tergal margins of segment 7 and 8 with wing-like prolongations or these only present on segment 7; segment 10 in the female without the broadly dilated orbicular plate found in *Petalia*, narrow and rounded below; anal appendages: superiors of about the length of segment 10, spatulate, slightly twisted and curved, slightly variable in the species; inferior a broad trifold plate considerably longer than the superiors, the lateral upturned spines robust, comparatively short, the apical median lobe projecting far beyond, rounded or quadrate at apex.

Genitalia very similar to the last genus, the anterior hamules markedly dilated and foliate at their apices, the posterior projecting into the genital fossa and tufted with stout bristles at the apex; lobe short, markedly cleft at its spout-like neck, rounded or scrotal-shaped below. Vulvar scales short, broad and robust, armed with the usual pair of tactile stylets and stiff bristles at apex; anal appendages of female short, conical, pointed; genital plate beneath segment 10 coated with numerous short spines as in many Aeschnines.

Genotype.—*Phyllopetalia stictica* Hagen.

Distribution.—From Chile only. Four species have been described, viz., *P. stictica*, *apicalis*, *apollo* and *decorata*. Of these *P. decorata* appears to me to be synonymous with *P. apicalis* and is treated as such here. *P. stictica* and *P. apicalis* are distinct by the shape of their anal appendages, both differing from those of *P. apollo*, whilst they differ in themselves by the markedly different shape of the frons.

Phyllopetalia stictica Hagen-Selys.

Phyllopetalia stictica, Hagen, *in lit.*; Selys, *Mon. Gomph.* p. 357 (1857); *Id.*, *Bull. Acad. Roy. Belg.* (2) VII, p. 550 (1859); *Id.*, *ibid.*, (2) XLVI, p. 694 (1878); Kirby, *Cat. Odon.* p. 82 (1890). Coll. Selys, 1 ♀, Chile; coll. Maclachlan, 1 ♀, Chile; coll. Hagen, Mus. Com. Zool. Mass. 1 ♂, the type, Valdivia, Chile.

Male.—Abdomen 46 mm. Hindwing 35.5 mm.

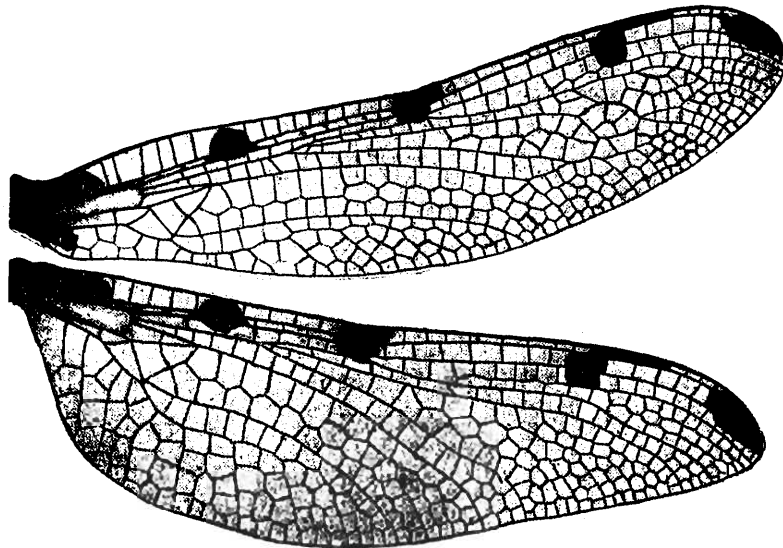
Head.—Labrum and labium cupreous yellow; clypeus yellow; frons black, the crest narrowly olivaceous, steeply conical as seen from the front, the crest rising as a pyramid which is without a notch above, whilst seen in profile it is globular; eyes meeting for a very short space, tumid behind; occiput blackish brown, small, triangular.

Prothorax and thorax brown, coated thickly with short blackish grey hairs. The thorax with two narrow dorsal stripes diverging below, and two narrow oblique stripes all pale yellow. Between the lateral stripes, an upper poorly defined whitish spot.

Legs long, slender, black; femora reddish brown changing to black distally; tips of claws reddish brown, tarsi black.

Wings hyaline marked along the costal margin with five small reddish brown spots as follows;—A small basal streak extending outwards as far as halfway between the base and the first antenodal nervure, a small rounded spot between the base and node, a larger more quadrate spot at the node, a very small rounded or oval spot below the proximal end of pterostigma and lastly a small oval spot at the apex of each wing. In the hindwings the spot between base and node is reduced to a mere point, whilst the basal one is smaller than

that in the forewing. Pterostigma covering about 2 cells, its robust brace running from a short distance from its proximal end, dark brown; membrane white, short, very narrow; only a single row of postcostal cells in the forewings; 1 cubital nervure in all wings; supra-triangles traversed once; anal triangle composed of 3 cells; nodal index $\frac{11-12}{8-8} \mid \frac{12-13}{8-8}$



TEXT-FIG. 7.—Wings of *Phyllopetalia stictica* Selys, ♀. (The apical half of the forewing is teratological.)

Abdomen tumid at base and again at the three terminal segments, tapering in between, segments 7 and 8 with the tergal margins dilated as wing-like structures distad the jugal sutures. Coloured blackish brown; segments 1 and 2 with ill-defined yellow spots, the latter with a latero-basal spot extending on to the dorsum of the oreillets which are large and bear several minute black spines on the apical margin; segments 3 to 6 with a longitudinal dorsal yellow stripe bisected by the middorsal carina which is finely black, the yellow band falling short of the apical border of each segment and crossed at its middle by the fine black jugal suture; in addition, each segment with a latero-basal yellow spot on each side; segments 7 and 8 with the dorsal band stopping short at the jugal suture; segments 9 and 10 with the dorsal yellow band largely obliterated by a middorsal black stripe.

Anal appendages; superiors about equal to segment 10 or slightly shorter, broadly foliate, widening at the middle, rounded at apices, black; inferior one-third longer than the superiors, black margined with brown, concave above, convex below, shaped as a broad trifid plate, the lateral lobes of which curve strongly up as robust spines, the middle one produced slightly beyond them and rounded broadly at the end.

Female.—Abdomen 47 mm. Hindwing 38 mm.

Closely similar to the male in colouring. The wing spots larger, the base of hindwings rounded, the abdomen stouter, more cylindrical throughout, the leaflike dilatations on segments 7 and 8 a little smaller, segment 9 longer than 8, and 10 very short and with the narrow dentigerous plate beneath it coated with short spines as in some species of *Anax* and *Aeschna*. The vulvar scales robust extending to end of abdomen and armed with the pair of tactile organs and the pair of stiff hairs below these as seen in *P. punctata*. Wings paly tinted especially at basal half, discoidal triangles all 2-celled, supratrangles traversed once or entire; anal loop absent; 1 cubital nervure in all wings; nodal index $\frac{11-13}{8-10} \mid \frac{13-10}{11-8}$.

Distribution.—Only three specimens of this rare insect are known, 1 male and two females, all from Valdivia, Chile. The male closely resembles *P. apicalis* but is a much smaller insect and is easily distinguished by segments 7 and 8 dilated at the margins, whereas only segment 7 is dilated in *P. apicalis*.

In the Selysian collection a female, labelled as *P. stictica*, bears an extra costal spot midway between the nodal and the one below the pterostigma, this spot broadly T-shaped, the nodal and pterostigmal spots are very large, the former irregular in shape, the latter quadrate. There is also a small spot on the upper part of arc in all wings and the antenodal nervures in the subcostal space all bear tiny spots at their base. The placing of this specimen seems extremely doubtful and I am inclined to treat it as one of *P. apollo*.

[**Phyllopetalia apicalis** Selys.]

Phyllopetalia apicalis, Selys, *Mon. Gomph.* p. 359 (1857); *Id.*, *Bull. Acad. Roy. Belg.* (2), VII, p. 550 (1859); Kirby, *Cat. Odon.* p. 82 (1890).

Phyllopetalia decorata, Selys, *Bull. Acad. Roy. Belg.* (2), XLVI, p. 695 (1878).

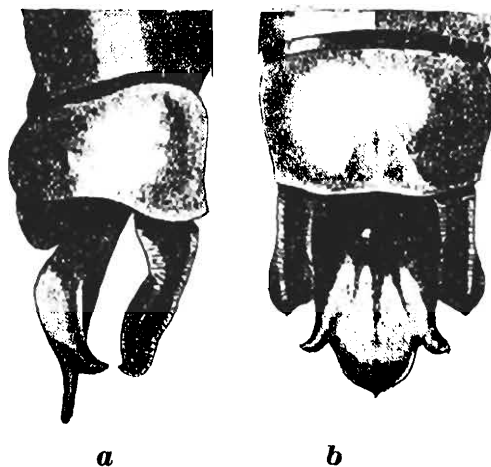
Coll. Paris Mus. 1♂, Chile; coll. Hagen, Mus. Com. Zool. Mass. 1 ♂, Valdivia, Chile; coll. MacLachlan, 1 ♂, Chile. (The latter the type of *P. decorata*); coll. Br. Mus. 1 ♂, Chile.

Male.—Abdomen 57 mm. Hindwing 40-42 mm.

Head.—Labium and labrum cupreous yellow, the latter broadly bordered with black; clypeus and bases of mandibles yellow; frons, vertex and occiput black, the latter fringed with stiff greyish hairs, the former with black hairs, very broad and flattened above, differing markedly from that of *P. stictica*; eyes dark brown, meeting at a point only.

Prothorax and thorax dark brown marked exactly as in *P. stictica*.

Wings hyaline tinted with pale yellow at base and along costa; reticulation and costa black; each wing bearing 5 small reddish brown spots along the costa nearly equidistant from one another, one at the base, elongated, sometimes divided into two and extending



TEXT-FIG. 8.—Anal appendages of *Phyllopetalia apicalis* Selys, ♂. *a.* Left lateral view. *b.* Dorsal view.

slightly distad the first antenodal nervure, whilst behind, it is fused with a blackish spot against the membrane; a second spot on the distal primary nervure, rounded; a similar spot on the node but extending further into the wing; an oval small spot at the proximal end of pterostigma; lastly an oval spot at the apex of each wing; membrane white, very short; pterostigma dark reddish brown, covering 2 to 3 cells, its robust brace situated slightly

distad the proximal end of pterostigma and passing through the centre of the coloured spot there; nodal index $\frac{10-14}{7-10} | \frac{13-13}{8-9}$, $\frac{9-13}{8-9} | \frac{12-9}{9-8}$; base markedly excavate, tornus markedly angulated; anal triangle 3-celled; anal field 5 cells deep in hindwing; discoidal field 2 cells deep to inner end of bridge; postcostal space of forewings with 2 rows of cells (only 1 row in *P. stictica*). *IA* markedly pectinated; *Riii* and *Riv+v* markedly undulated; *Rspl* well defined. Legs similar to *P. stictica*.

Abdomen tumid at base and at the end segments, only segment 7 furnished with wing-like prolongations at the tergal margins. Coloured and marked similarly to *P. stictica*. Anal appendages not differing in shape from those of the same species.

Distribution.—Valdivia, Chile. Very few specimens of this rare insect are known. The type of *P. decorata* in the Maclachlan collection has the end of the abdomen in too poor a condition to compare with *P. apicalis* and I have been unable to distinguish any reliable points to differentiate it from *P. apicalis*. Selys gives the three following distinguishing characters for *P. decorata*.—The crest of frons a little yellow and notched at the middle; anal triangle made up of 4 cells (3 in *P. apicalis*), costal spots smaller. The first and second of these characters may be due to tenacity and distortion in paper packets. The male in the British Museum, apparently determined by the late Mr. Champion, compares more closely with the description of *P. apicalis*. The latter insect also compares in size to *P. decorata*, both being markedly larger than *P. stictica*. (Dimensions of type of *P. decorata*.—Abdomen 56 mm. hindwing 44 mm.) *P. apicalis* is at once distinguished from *P. stictica* by its much larger size, by having only segment 7 dilated at the margins and by having 2 rows of post-costal cells in the forewing instead of only one. It is distinguished from *P. apollo* by having only segment 7 dilated, 7 and 8 being dilated in the latter insect as in *P. stictica*.

[*Phyllopetalia apollo* Selys.]

Phyllopetalia apollo, Selys, *Bull. Acad. Roy. Belg.* (2), XLVI, p. 695 (1878); *Id.*, *Bol. Viaje al Pacif. Neur.*, p. 4 (1884); Kirby, *Cat. Odon.*, p. 82 (1890).

Coll. Selys, 1 ♂, 2 ♀, (The male labelled also "*P. apicalis*," without data), one female labelled "Peru," the other without data; coll. Maclachlan, 1 ♂, Chile.

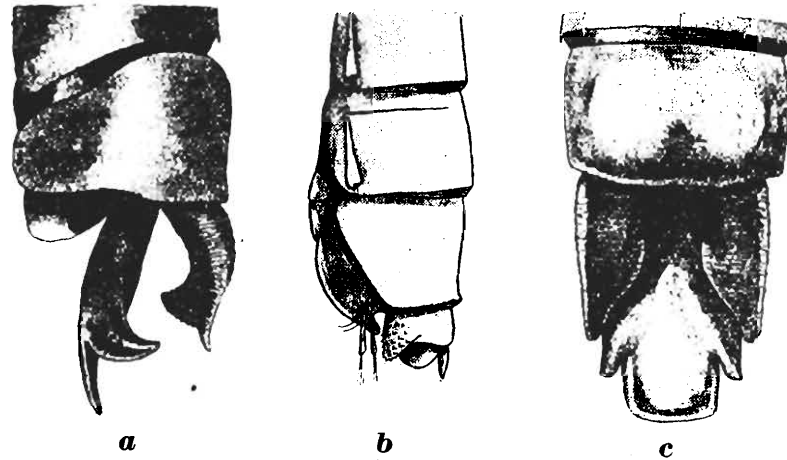
Male.—Abdomen 51 mm. Hindwing 38 mm.

Head.—Labium and labrum cupreous, the latter margined with blackish brown; clypeus yellowish; frons and occiput blackish brown, the former with an ill-defined yellow stripe along the crest marked outwardly by a linear black spot, rounded at crest and elevated but not to the extent seen in *stictica* or as depressed as in *P. apicalis*; eyes very tumid and yellow behind, meeting at a point only, brown in colour.

Prothorax and thorax marked as in *P. apicalis* and very much as in *A. patricia*.

Wings hyaline, palely enfumed at bases or tinted with yellow over the same area and marked along the costal border with a row of six reddish brown spots as follows;—An oblong basal spot extending distad as far as the second antenodal nervure on the hindwing, and nearly as far in the fore, a fusiform spot midway between the node and base of wing, expanding in the subcostal space and overlapping it behind in the hindwing, a very large sub-quadrate spot at the node, broadly overlapping that structure distad, a broad T-shaped spot midway between node and pterostigma, a quadrate spot occupying 2 rows of cells at the proximal end of pterostigma and bisected by the brace of latter, lastly a large oval

spot at the apex of wings; anal triangle 3-celled; anal loop absent; all discoidal triangles 2-celled; supratrangles all entire; nodal index. $\frac{12-15}{10-9} | \frac{16-11}{9-9}$; membrane narrow, white.



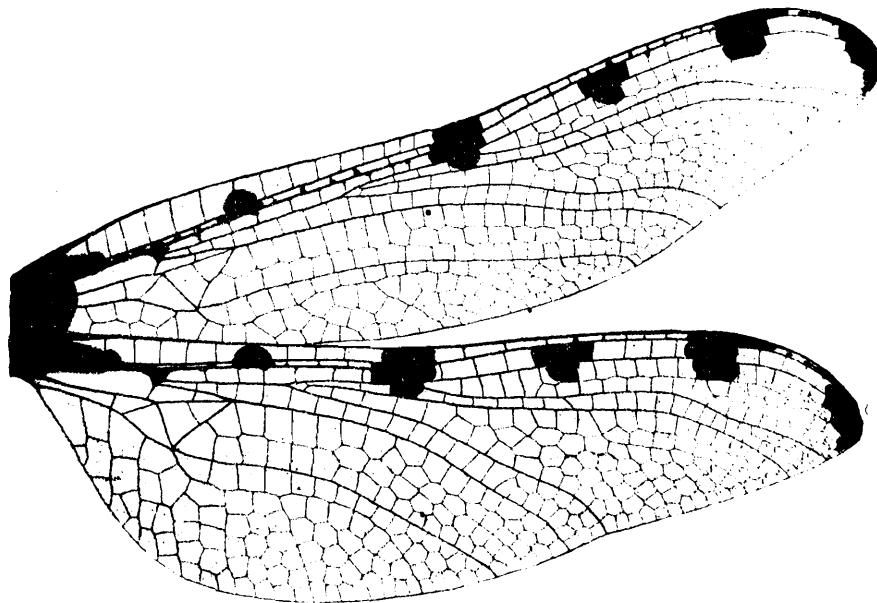
TEXT-FIG. 9.—Anal appendages of *Phyllopetalia apollo* Selys, ♂. a. Left lateral view. c. Dorsal view. b. Female genitalia of same species.

Abdomen coloured and marked very much as in *P. apicalis*. Legs black, femora reddish brown at proximal ends.

Female.—Abdomen 49 mm. Hindwing 43-45 mm.

Coloured and marked similarly to the male, differing only in sexual characters, the abdomen more cylindrical and of even width throughout, segments 7 and 8 with winglike prolongations of the tergal margins but much smaller than in the male in which they are very prominent structures; segment 9 longer than segment 8; segment 10 very narrow and short, its dentigerous genital plate coated with small spines beneath; vulvar scales robust, extending to end of abdomen and armed with stylets and bristles as in *P. stictica*.

Wings with the costal spots considerably larger than in the male and with a chain of small coloured dots between the basal and following spot, situated on the antenodal nervures; nodal index $\frac{11-14}{10-10} | \frac{15-11}{9-10}$, $\frac{9-15}{10-9} | \frac{15-8}{11-10}$; supratrangles traversed once or entire; all discoidal triangles traversed once; anal triangle rarely present (5-celled in one specimen).



TEXT-FIG. 10. Wings of *Phyllopetalia apollo* Selys, ♀.

Distribution.—Chile. One of the Selysian females is labelled “Peru,” but this locality seems doubtful. The species bears a remarkable resemblance to *A. patricia*, the first specimen of the latter having been determined by so great an authority as the late Dr. Ris as *P. apollo* and described as such by Dr. R. Tillyard. It may be distinguished however by the wing spots reddish brown instead of clear ruby red as in *A. patricia*. From *P. stictica* this species is distinguished by the frons less elevated and less conical and also by the larger size and number of the costal wing spots; from *P. apicalis*, the presence of dilated tergal margins on segments 7 and 8, instead of only on segment 7, will serve to separate it. Selys gives the female as unknown, but there are two specimens in his collection in the Brussels Museum labelled as such from which the above description has been taken, and these were probably acquired after the publishing of the initial description of the male in 1878.

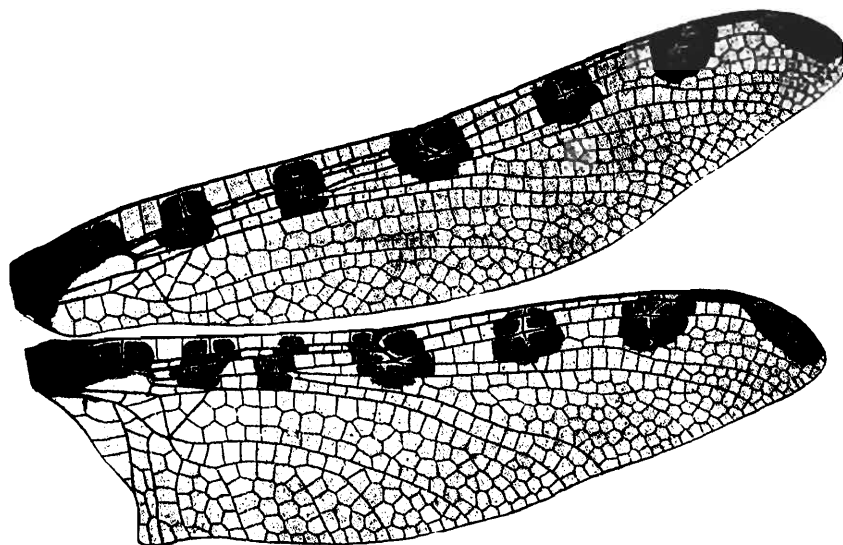
Genus *Hypopetalia* MacLachlan (1870).

Hypopetalia, MacLachlan, *Trans. Ent. Soc. London*, p. 170 (1870).

The largest insects of the group. Head narrowed antero-posteriorly, elongate from side to side, eyes meeting very narrowly; occiput a little tumid behind, fringed with coarse hairs posteriorly; face broad, overlapping the genae; frons high, as high as the occiput, rounded above at crest.

Thorax short, robust, finely downy; legs of moderate length, hind femora extending nearly to end of segment 1 and armed with two rows of short evenly-sized robust spines; tibial spines moderately long and thick.

Wings long, narrow, very pointed at apices, reticulation very close, base of hindwing sharply bevelled and obtusely excavate, tornus markedly angulated. Hyaline marked



TEXT-FIG. 11.—Wings of *Hypopetalia pestilens* MacL., ♂.

with a row of seven reddish brown, pale centred costal spots as follows.—An elongate one at apices of wings, one below the pterostigma, one between this and the node, a very large one at the node, two between the node and base of wing and lastly an irregular elongate spot at bases of wings. Pterostigma very long and very narrow, especially in the hindwing, strongly braced but *the brace lying slightly proximal of the proximal end of the organ*, covering from 3 to 5 cells; discoidal cell lying rather more distad the level of arc than

in other species of the group and at about equal distance in fore- and hind-wings, shaped rather similarly in the wings, but that of forewing slightly narrower in the length of the wing, distal side slightly longer than the costal and both considerably longer than the basal, *formed of 3 cells in fore- and hind-wings*; subtriangles differently shaped, that of forewing made up of 3 cells, that of the hind 2-celled; discoidal field beginning with 2 rows of 3 cells in the forewing, followed by 3 rows of 2 cells and then again rows of 3 cells, finally strongly dilated at the margin of wing; 1 cubital nervure in all wings; anal triangle very large, 5 to 6-celled; anal loop absent supratrangles traversed once in all wings; *IA* markedly pectinate in both fore- and hind-wings; *Cuiv* in forewings broadly arched; arc but slightly angulated; no basal incomplete postcostal nervures present; membrane almost obsolete; *Rspl* and *Mspl* weakly formed but distinct in forewings; *Riii* and *Riv+v* markedly undulated; anal field of hindwing 6 to 8 cells deep.

Abdomen long, slim, cylindrical, slightly dilated at the base, slightly constricted at segment 3; oreillets on segment 2 enormous; segments 7 and 8 slightly dilated but without lateral winglike prolongations at tergal margins. Anal appendages: superiors about as long as segment 10, simple, spatulate, obtusely pointed as seen from above, tapering rapidly as seen from the side; inferior about one-third longer than superiors, shaped as a broad trifid plate, broadly rounded at the apical border of median lobe, convex below, deeply concave above, lateral lobes thick robust spines curling strongly up and backwards.

Genitalia very similar to group type. (In the specimen in the Selysian collection, the genital fossa is filled in with cement and its characters thus largely hidden; I failed to make an examination of the Maclachlan specimen, which is the type.)

Geno-type.—*Hypopetalia pestilens* Maclachlan.

Distribution.—Only a single species is known of this genus, which comes from Chile¹ It stands rather apart from the rest of the group by broad venational differences. These are the shape of the discoidal cells which have 3 cells in all wings and the 3-celled sub-triangle of the forewings, the shape of the anal triangle which has as many as 5 or 6 cells, and the more modern, proximal position of the robust brace of the pterostigma. *Riii* is strongly undulated as in *Phyllopetalia*. It is probably a more modern insect than the rest of the group.

***Hypopetalia pestilens* Maclachlan (1870).**

Hypopetalia pestilens, Maclachlan, *Trans. Ent. Soc. London*, pp. 170-172 (1870); Selys, *Bull. Acad. Roy. Belg.* (2), XXXV, p. 773 (1873).

Coll. Selys, 1 ♂; coll. Maclachlan, 1 ♂, the type, both from Chile; 1 ♀ Berlin Univ. Mus. Male.—Abdomen 64 mm. Hindwing 50 mm.

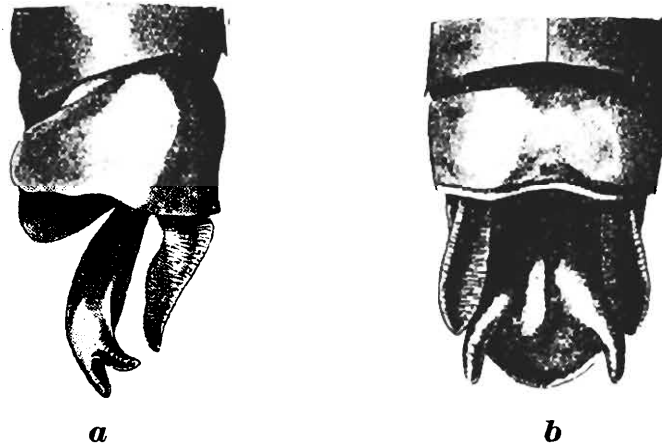
Head.—Labium yellowish; labrum brownish bordered with paler yellow; bases of mandibles yellow; clypeus and frons olivaceous brown, the latter with a broad band of yellow

¹ Since the above was written, Dr. Eric Schmidt of Berlin has sent me the photograph of the wings of a female of *H. pestilens*, discovered in the collection of the Zool. Museum of the University of Berlin. From this photo it is seen that the markings of the female wings are approximately similar to those of the male and certainly not more extensive. The discoidal triangles of the forewings are 4-celled instead of 3, and the subtrigones of both fore- and hind-wings are 2-celled, thus differing from the male. Hindwings are well rounded at base; nodal index closely similar. Dr. Schmidt has also communicated the details of the genital plate which from its broad shape clearly shows that this genus is closely related to *Petalia* which has a similar plate. He states also that there are twenty unnamed specimens of *Petalinae* in the same collection.

on the crest which is fringed thickly with coarse black hairs; vertex and occiput black, the latter fringed with long black hairs; eyes brown.

Prothorax brown densely clothed with short grey hairs.

Thorax dark reddish brown, the middorsal ridge broadly black, the sides paler olivaceous brown marked on the mesepimeron with a large round greenish white spot lying on a black background, and by a short oblique similarly coloured stripe below it also bordered heavily with black. Beneath fuscous clothed thickly with short greyish downy hairs. Legs black, extensor surfaces of femora reddish brown.



TEXT-FIG. 12 — Anal appendages of *Hypopetalia pestilens* MacL., ♂. a. Left lateral view. b. Dorsal view.

Wings hyaline marked along the costa by a row of reddish brown spots some of which have paler centres as follows;—A broad streak at the base of each wing extending distad as far as the 2nd antenodal nervure and crossing the median and cubital spaces obliquely to the anal vein; an irregular spot covering 2 antenodal intervals and extending posteriorwards as far as *MA* lying at the junction of the basal and middle two-thirds of the subcosta; a similar spot more regular in the forewing, less so in the hind, covering a similar area and lying midway between the last spot and the node; a very large nodal spot, the subnode traversing its centre which is irregularly hyaline; a rounded spot lying midway between the node and pterostigma, bounded by the costa and *Riii* or *IRiii*, a large spot near the pterostigma, its distal border slightly overlapping the proximal end of pterostigma; finally an elongate spot at the apex of each wing slightly overlapping the distal end of pterostigma and occupying about 3 to 4 rows of cells. In most of these spots the reticulation of the wings forms a hyaline network. Discoidal cells of both wings made up of 3 cells; sub-triangle of forewing 3-celled, 2 cells in the hind; 5 to 6 cells in the anal triangle; 2 rows of cells in the postcostal area of forewing, 7 to 8 in the anal field of the hind; 1 cubital nervure in all wings; nodal index $\frac{13-15}{14-11} \mid \frac{16-13}{11-14}$; pterostigma pale yellow including the costa, rather darker at its inner end, covering $2\frac{1}{2}$ to 4 cells. In the MacLachlan specimen, which is somewhat teneral, the costal spot lying nearest the nodal spot in the subcostal space is very small in the forewings and quite absent in the hind, whilst the spot proximad to it is broken up into secondary smaller spots.

Abdomen blackish brown, markings in the two known specimens obscured by decomposition, although there is slight evidence of paler markings at the sides of segments 2 to 7 and dorsal ones on segment 2 which are probably pale green in the living state.

Anal appendages : superiors as long as segment 10, seen from the dorsum broad, slightly dilated at the middle and then narrowing rapidly to a somewhat obtuse point, laterally very broad at base, sinuously twisted, tapered gradually to a rather acute point, the surface minutely rugose. Inferior deeply concave above, equally convex beneath, trilobate, the lateral lobes robust, upwardly, outwardly and backwardly directed spines, the median lobe projecting but very slightly beyond them and broadly rounded at its apex.

Easily distinguished from all other species by the very large costal coloured spots, far more extensive in this than in any others.

Family PETALURIDAE.

Dragonflies of large or very large size, some attaining to the largest size known in the order ; characterized by the excessively long and very narrow pterostigma, by the wide separation of the eyes, by the pointed wings with very close reticulation, and, in the female, by the Aeschnine like ovipositor curved strongly dorsalwards at the apex.

Head massive, transversely elongate ; labium triangular, longer than broad, cleft at its middle lobe, each half of which ends in a fine spine, lateral lobes very large, outer border strongly rounded, inner border sinuous and ending in a long robust spine ; labrum broader than long, shallowly notched at anterior border, rounded at the ends ; antennae with basal joint short, second joint slightly longer and tapered at end, third joint segmented or not, when the former, the first segment as long as the two basal segments, the second and third gradually shortening ; face flat, oblique or projecting, very broad below and overlapping the genae ; frons elevated, rounded or flattened above ; occiput variable, tumid or with or without short robust spines.

Prothorax small, more or less concealed by the head.

Thorax very massive, hairy, with or without a robust spine on each side. Legs long and robust, extending on to the second abdominal segment, hind femora furnished with two rows of closely-set, evenly-sized, small spines ; tibial claws small, situated nearer the base than apex of claws.

Wings usually very long, rather narrow and very pointed at apices, hyaline, unmarked by costal spots, reticulation very close ; base of hindwing in the male very excavate, tornus very angulate, base rounded in the female ; pterostigma very narrow and very elongate, braced, the brace situated at proximal end or proximal to the end, markedly so in some species ; membrane small, almost obsolete ; discoidal triangles differing in shape in the fore- and hind-wings, that of forewing usually with costal and basal sides subequal and longer than the distal, that of hindwing with costal and distal sides equal and much longer than basal, entire or 2 to 6-celled, situated well distad the level of arc ; subtriangles of forewings 2 to 3-celled, entire in the hindwing ; supratrangles usually entire, occasionally traversed once ; discoidal field of forewing begins with a row of 3 or 4 cells and is then continued as rows of 2 cells as far as bridge, widely dilated at termen ; node situated near middle of wings or a little proximad of that point ; arc nearly straight ; *Riii* not undulated ; median space entire ; basal space traversed once or twice ; no accessory basal antenodal nervures present ; anal loop well developed ; anal triangle large, 3 to 4-celled ; antenodal nervures numerous, the first and the fifth to eighth the primaries.

Abdomen cylindrical, dilated at base, tapered somewhat as far as the end or as far as segment 7, from which it gradually dilates again; stouter and more evenly cylindrical in the female, longer than the wings in both sexes; segment 10 in the female very short, narrow, without a genital plate beneath, tilted strongly up by the ovipositor.

Genitalia.—Variable in the genera; oreillets small and inconspicuous in both sexes; lamina depressed, deeply but narrowly arched; anterior hamules broad foliate curled plates; posterior hamules variable in the genera; lobe rounded, scrotal-shaped, narrowly lipped. Female: ovipositor very robust, extending beyond end of abdomen as a rule, Aeschnine in shape and tilted strongly up at apex so as to displace the 9th and 10th abdominal segments basalwards; furnished at the apex with a pair of tactile stylets tipped with short stiff bristles at the ends.

Anal appendages variable in the genera, especially unique in genus *Phenes*; superiors usually longer than inferiors and enormously dilated as wing-like structures, especially in genus *Petalura*; inferior narrow or broad, triangular or quadrate, hatchet-shaped or very narrow and produced far beyond the superiors.

Distribution.—Of the five genera known, one is confined to N. America, another to Japan, one to New Zealand, one to Australia and the fifth to S. America. Specimens are rare in collections and the genera do not contain more than one to three species. The larvae of three species are known and all agree in living in marshes and swamps, burrowing deeply in the mud and living a semi-aquatic existence. In their morphology these larvae combine Gomphine and Aeschnine affinities, but perhaps more of the latter, and go to prove that the *Petaluridae* are a very primitive race. Their distribution is discontinuous and suggests that they were at one time widely and universally distributed but that with the progress of evolution wider and wider gaps occurred, until but a few isolated remnants remain to tell us of a race of giants which is now all but extinct.

Subfamily PETALURINAE.

Characters very similar to those of the *Tachopteryginae* but differing in the following particulars;—Occiput without the small scattered spines, with or without three robust posterior horns; face variable, usually deep and broad especially below, where it overlaps and conceals the genae; frons variable, rounded or flat above or shallowly emarginate; antennae with the filament entire or segmented.

Prothorax with the posterior lobe variable, usually small and inconspicuous; thorax without a ventral tubercle, with or without a robust lateral spine. Legs longer, hind femora extending beyond segment 1 and furnished with two rows of short, evenly-sized, closely-set spines.

Wings with discoidal triangles of forewings 2 to 6-celled, costal side shorter or longer than basal; supertriangles entire or traversed once; anal triangle 3 to 4-celled; anal loop well-developed. Anal appendages very variable in the genera.

Genitalia variable in the genera but broadly comparable to that of the *Tachopteryginae*.

Distribution.—That of the family except Japan and N. America. Confined to the Southern hemisphere.

Key to the genera.

- | | | | | |
|---|---|---|---------|----------------------------|
| 1 | { | A robust spine on each side of thorax ; occiput with three small posterior horns ; inferior anal appendage longer than superiors, very narrow and curled at first down and then strongly up ; superior anal appendages L-shaped, hollowed plates apposed to one another .. | .. | <i>Phenes</i> Rambur. |
| | | No spines on sides of thorax ; no posterior horns on occiput ; inferior anal appendage shorter than superiors, variable, usually very broad, dilated, and leaf-like structures | | 2. |
| 2 | { | Species of great size, abdomen 64 to 92 mm., hindwing 52 to 71 mm.; filament of antennae entire ; costal side of discoidal triangle of forewing shorter than the basal and distal which are subequal ; inferior anal appendages much shorter than the superiors .. | .. | <i>Petalura</i> Leach. |
| | | Smaller species with abdomen 43-67 mm., and hindwing 34-55 mm.; filament of antennae segmented ; costal side of discoidal triangle longer than basal but shorter than distal ; inferior anal appendage but slightly shorter than or equal to the superiors .. | | 3. |
| 3 | { | Inferior anal appendage tapered to apex ; brace of pterostigma situated proximal to its proximal end ; subnode meeting bridge at its middle ; subtriangle of forewing of the same size as that of hind | .. | <i>Uropetala</i> Selys. |
| | | Inferior anal appendage greatly broadened at its apical border ; brace of pterostigma situated at the proximal end ; subnode meeting bridge at the junction of middle and distal thirds ; subtriangle of forewing much larger than that of hind | | 4. |
| 4 | { | Colours largely olivaceous ; inferior anal appendage notched at apex ; reticulation very close ; <i>IA</i> in hindwing with 6 to 8 branches ; anal loop 5 to 7-celled ; ovipositor not extending to end of abdomen and scarcely displacing dorsalwards segments 9 and 10 .. | .. | <i>Tachopteryx</i> Selys. |
| | | Colours black marked with citron yellow ; inferior anal appendage with a small median projection at apex ; reticulation more open ; <i>IA</i> with only 4 to 6 branches ; anal loop 2 to 4-celled only ; ovipositor extending beyond end of abdomen and displacing end segments of abdomen upward | | <i>Tanypteryx</i> Kennedy. |

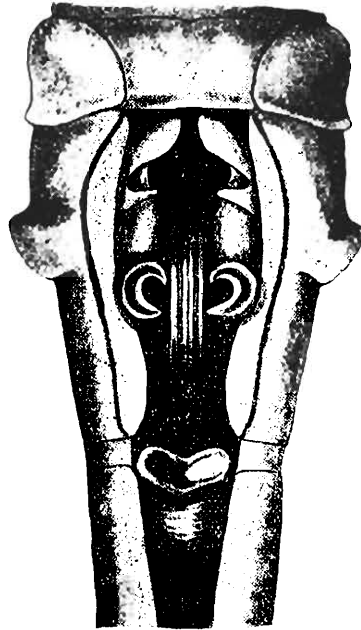
Genus **PETALURA** Leach (1815).

Petalura, Leach, *Zool. Misc.* II, p. 96 (1815) ; Selys, *Bull. Acad. Roy. Belg.* (2) XXI, p. 110 (1854) ;
Id., *Mon. Gomph.* p. 365 (1857).

Head massive, broader than deep ; eyes well separated, tumid behind ; frons raised and very prominent, rounded in front, shallowly grooved above ; vertex very minute, the two outer ocelli stalked ; labium longer than broad, cleft at its middle, with a spine on each side of the notch ; antennae made up of only 3 segments, the stylus unjointed ; occiput tumid behind, rounded above, very hairy and coated with tiny black points.

Prothorax and thorax very massive, very hairy laterally, the thorax without a spine on lower anterior part of mesepimeron. Legs very long, very robust ; hind femora with a

row of evenly sized, closely-set, short spines which gradually lengthen towards the distal end of limb.



TEXT-FIG. 13.—Genitalia of *Petalura gigantea* Leach, ♂.

Wings hyaline, very long and moderately broad, reticulation close, base of hindwing markedly excavate, tornus markedly angulate; membrane almost obsolete, very narrow; pterostigma of great length and extremely narrow, situated far from apex of wings, its well-developed brace situated slightly proximal of its inner end; subcostal nervure not prolonged beyond the node; discoidal cells differently shaped in fore- and hind-wings, that of forewing with basal and distal sides subequal, the costal side considerably shorter, traversed horizontally by two nervures and made up of 3 cells; that of hindwing with costal side a little shorter than distal and the basal much shorter than either, traversed vertically once and made up of 2 cells; subtrigone of forewing variably reticulated, made up of 3 to 6 cells, rather larger than discoidal cell in the forewing but very much smaller in the hind where it is entire; supratrangles entire; antenodal and postnodal nervures numerous; bridge traversed many times, the oblique nervure being situated far distad; discoidal field beginning with a row of 4 cells and then continued for a short distance as rows of 3 cells; the nervure *IA* pectinate especially in the hindwing where it is forked; *C_{iii}* in forewing broadly and flatly arched; anal loop variable, present or absent or open below; sectors of arc arising from centre of arc and gradually diverging distad; median space entire; one cubital nervure in all wings; anal triangle made up of 3 to 4 cells, usually only 3; no basal post-costal nervure present.

Abdomen very long, cylindrical, rather tumid at base, gradually tapering thereafter; segments 8 and 9 with lateral borders slightly dilated in the male; segments 1 and 2 very hairy; oreillets very prominent, deeply grooved above.

Anal appendages; superiors very narrow at base, broadening markedly thereafter to form large membranous foliate structures, the inner border concave, the outer markedly convex, the apical border finely crenulate, a short but robust spine on the inner under side of base and a robust keel or midrib running from base to apical border lying nearer the inner than outer border; inferior appendage considerably shorter, shaped like the head of a battle-

axe as seen from below and sometimes with a fine median point at the centre of its apical border the outer ends of which are prolonged as tapering points.

Genitalia: lamina broad, deeply cleft, depressed; anterior hamules broad curled foliate plates; posterior hamules short strongly curled chelate hooks; lobe short and broad, scrotal-shaped.

Vulvar scales robust, short and triangular, curling strongly upwards and tilting the 9th and 10th abdominal appendages which are perched above them.

Genotype.—*Petalura gigantea* Leach.

Distribution.—New Holland, Queensland, Australia. The genus differs from *Phenes*, its nearest ally, by the occiput without spines or horns, the sides of thorax without a prominent spine on the mesepimeron and by the very differently shaped anal appendages. Differs from genus *Uropetala* by the differently shaped discoidal cells, by the unjointed stylus of antennae and by the broad flattened inferior anal appendage.

***Petalura gigantea* Leach (1815).**

Petalura gigantea, Leach, *Zool. Misc.* II, p. 96, tab. 95 (1815); Selys, *Bull. Acad. Roy. Belg.* (2) XXI, p. 110 (1854); *Id.*, *Mon. Gomph.* p. 366 (1857); Tillyard, *Proc. Linn. Soc. N. S. Wales*, XXXIV, p. 697, Pl. xxiv (1909); *Id.*, *ibid.*, XXXVI, Part I, pp. 88-96, pl. VII, figs. 1-4 (1911); *Id.*, *ibid.*, XXXVII, p. 583 (1912).

Coll. Selys, 5♂♂, 4♀♀, (Two of the males in poor condition, one teneral); coll. Tillyard, several of both sexes; coll. Br. Mus. both sexes.

Male.—Abdomen 64-73 mm. Hindwing 52-56 mm.

Head.—Labium brownish; labrum yellow bordered with brown and with a small median black point at middle of base; ante- and post-clypeus dark brown changing to black below; frons yellow with a blackish brown transverse stripe on the lower part adjoining the post-clypeus, its base above narrowly black, this colour prolonged forwards slightly in the median sulcus; vertex black; occiput brown, very hairy and speckled with tiny black points, a large black spot behind against the eyes, which latter are dark brown.

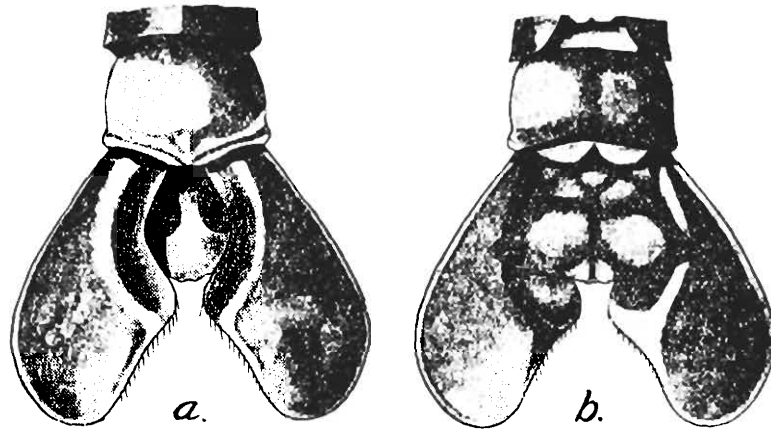
Prothorax black coated with long greyish hairs; the anterior lobe and middle portion of the posterior bordered with yellow; a diffuse yellow spot on the middorsum of middle lobe.

Thorax coated with long hair, dark brown marked with yellow as follows;—A broad elongate dorsal spot lying close alongside the middorsal carina on each side, extending upwards and tapering as far as antalar sinus which latter is yellow framed finely in black; two oblique parallel stripes on each side of thorax, the anterior on the mesepimeron confluent with its fellow on the opposite side across the tergum between the wings; the posterior stripe covering the hinder part of metepimeron; beneath yellow.

Legs black, pruinulent in old specimens.

Wings hyaline, reticulation dark brown, costa yellow; pterostigma blackish brown, covering 8 to 8½ cells, 9 to 10 mm. in length, its brace lying a short distance proximal to its inner end; membrane white; venation that of the genus; discoidal cell of forewing constantly 3-celled, that of hind 2-celled; subtriangle very variable, 3 to 6-celled in forewing; nodal index very variable $\frac{11-19}{10-16} | \frac{20-10}{14-9}$, $\frac{8-16}{?/?} | \frac{18-8}{14-9}$, $\frac{11-19}{11-14} | \frac{21-11}{16-10}$.

Abdomen dark brownish yellow or ochreous with black articulations to segments 2 to 7, jugal sutures also finely black; segments 2 to 8 with the middorsal carina finely yellow; segment 9 yellow on dorsum; segment 10 black bordered apically with yellow and with a small middorsal basal yellow spot; the sides of all ventrally black.



TEXT-FIG. 14.—Anal appendages of *Petalura gigantea* Leach, ♂. a. Dorsal view. b. Ventral view.

Anal appendages; superiors brown, much longer than segment 10, narrow and stalked at base where is seen a robust spine on the inner lower aspect, then broadening abruptly, subtriangular, outer border strongly convex, deeply concave on the inner which is shorter than the outer, these two borders forming a triangle with the apical which is finely crenulate and about equal in length to the inner border; a strong rib like the midrib of a leaf runs parallel and fairly close to the inner border. Inferior appendage yellow, nearly as broad and as long as segment 10 but shorter than superior appendages, its outer borders concave, the apical a little convex and prolonged strongly outwards each side to form a robust spine; the apical border with a minute central spine. Seen laterally the appendage is thick, presents a robust spine basad its centre above and is acutely pointed apicad. Genitalia as for genus.

Female.—Abdomen 58-71 mm. Hindwing 53-58 mm.

Coloured and marked similarly to the male. The black at base of frons above prolonged but slightly forwards or not at all; segments 8 to 10 black, with the base, apical border and midcarinal ridge finely yellow. Vulvar scales and anal appendages dark brown or black, the latter conical, obtuse at apex, slightly longer than segment 10.

Wings hyaline or palely suffused, the hind rounded at base; pterostigma longer than in the male, 11 mm. in forewings, 12 mm. in the hind, covering 11 to 12 cells; subtriangle occasionally 6-celled; anal loop 3-celled; nodal index $\frac{11-21}{11-16} \mid \frac{21-11}{15-12}$, $\frac{10-18}{10-14} \mid \frac{18-10}{15-11}$

Distribution.—New Holland, Australia. Differs from *P. pulcherrima* by its more robust build, by its duller colour and by the absence of the conspicuous yellow markings on abdomen; from *P. ingentissima* by its more robust build, smaller size, more yellow on the frons, dorsal thoracic stripes different, markings of abdomen very different and lastly by the subtriangles of forewings 3-celled instead of 6 or 7, this last feature furnishing a ready means of differentiation. Dr. Tillyard reports it from New South Wales (rare); Blue Mountains, Moss Vale, Sydney during November to January. The larva lives like a water rat in tortuous burrows in the mud of swamps. An interesting account of its life history has been given by Dr. Tillyard (*loc. cit.*)

[*Petalura pulcherrima* Tillyard (1913).]

Petalura pulcherrima, Tillyard, *Proc. Linn. Soc. New S. Wales*, XXXVII, Pt. 4, pp. 582-584, Pl. lxii, figs. 11-14 (1913).

Coll. Tillyard, 6♂♂, 1♀, one of the former the type.

Male.—Abdomen 77 mm. Hindwing 57 mm.

Head.—Labium yellowish; labrum bright yellow bordered with black anteriorly; genae yellow; anteclypeus and postclypeus blackish brown, the latter with a patch of yellow on each side; frons yellow with a large triangular spot of black on lower part of front adjoining the postclypeus; its base also black above; vertex and occiput black; eyes nearly black, separated by a space 2 mm. broad; ocelli conspicuous; antennae 4 mm. long, slender, black.

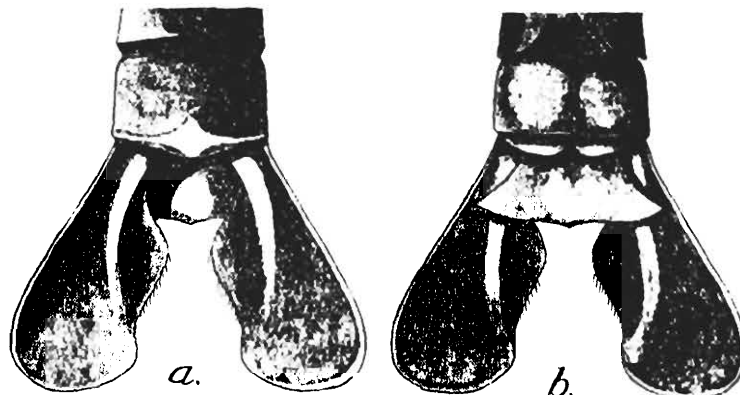
Prothorax black, posterior lobe yellow.

Thorax dark brown marked with a broad subtriangular yellow dorsal band split in two by the black middorsal carina and with its lower angles prolonged outwardly and its outer borders conspicuously concave; the antealar sinus yellow bordered with black; laterally two broad straight parallel yellow stripes.

Legs black, robust; hind femora 16 mm. in length, tarsi 11 mm.

Wings hyaline, reticulation black; pterostigma black, very narrow, 11 mm. long in forewings, 12 in the hind. (Further details of the wing including the venation are not given by the author, so presumably they do not differ greatly from those of *P. gigantea*.)

Abdomen slender, rather tumid at base, black marked with yellow as follows;—Segment 1 very hairy, blackish brown with an obscure yellow stripe on the middorsal carina and a patch of yellow on each side; segment 2 yellow with a broad longitudinal black stripe extending nearly the whole length of segment but separated narrowly from base and apex of segment by narrow yellow borders and equally narrowly divided along the middorsal carina by a fine yellow line; oreillets yellow, small and inconspicuous; segments 3 and 4 similar to 2 but the dorsal black stripes narrower, the lateral yellow correspondingly broader, jugal sutures finely black; segments 5 to 7 black with basal and apical yellow annules diminishing in breadth towards the anal segments; segment 8 black with a fine basal and a broad apical yellow annule; segment 9 with a broad apical annule the basal border of which is crenate, covering about two fifths of the segment; segment 10 black with a narrow basal ring incomplete outwardly; and its apical border narrowly yellow.



TEXT-FIG. 15.—Anal appendages of *Petalura pulcherrima* Till, ♂. a. Dorsal view. b. Ventral view.

Anal appendages : superiors black, 7 mm. in length by 5.5 mm. broad, foliate, shaped similarly to those of *P. gigantea* but narrower and more elongate ; considerably smaller than those of *P. ingentissima*. Inferiors dark brown, paler, 2 mm. long by 3 mm. broad, shaped intermediately between those of *P. gigantea* and *P. ingentissima*. Genitalia is similar to that of *P. gigantea*.

Female.—Abdomen 69 mm. Hindwing 61 mm.

Very similar to the male but the abdomen more cylindrical, shorter and broader ; the yellow markings more extensive and conspicuous.

Anal appendages short, straight, apices rather obtuse and with two stiff hairs projecting from the end, black. Vulvar scale extending to end of abdomen, curved up at end, with a stylus on each side and a row of short closely-set bristles on the keel beneath.

Distribution.—Cooktown, N. Queensland, Australia. Six males collected by Dr. R. J. Tillyard, January 1908, and 1 female collected by F. P. Dodd, December 1907. The species is distinguished from *P. gigantea* by its larger size and more slender build, by its conspicuous black and yellow colour pattern ; by the relatively more elongate anal appendages. From *P. ingentissima* by its conspicuous colour pattern, by the frontal portions of head much more yellow and by the relatively small size of the superior anal appendages.

[***Petalura ingentissima* Tillyard (1907).**]

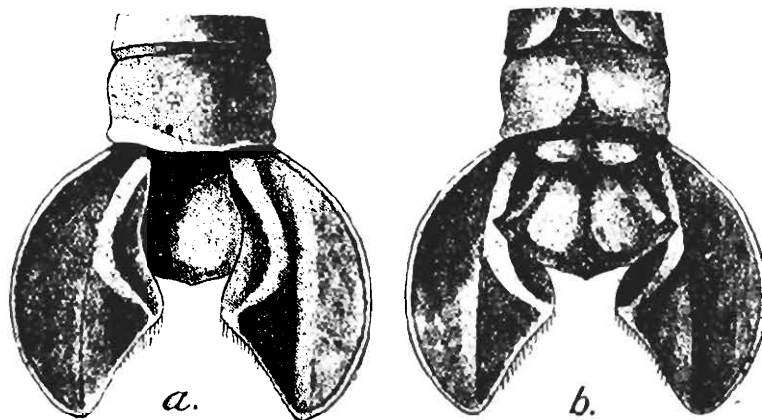
Petalura ingentissima, Tillyard, *Proc. Linn. Soc. N. S. Wales*, XXXII, Part 4, Sept. 25, (1907).

Coll. Tillyard, 1♂, 1♀, North Queensland, Cairns, Kuranda, Atherton and Herberton.

Male.—Abdomen 92 mm. Hindwing 71 mm.

Head.—Labium pale dirty greyish-yellow edged with dark brown ; labrum yellow bordered with black, the basal black projecting at the middle as a small tongue into the yellow ; bases of mandibles and genae yellow ; clypeus, vertex and occiput black ; frons yellow along the crest, broadly black in front and at the base where the black extends forwards slightly in the middle sulcus ; eyes dark brown separated by a distance of 3.5 mm.

Prothorax dark blackish brown, paler on the posterior lobe.



TEXT-FIG. 16.—Anal appendages of *Petalura ingentissima* Till, ♂. a. Dorsal view. b. Ventral view.

Thorax rich dark brown marked on the dorsum by two broad dull yellowish bands separated only by the dark brown narrow middorsal carina, the two stripes forming a sub-triangular area with its base adjoining the prothorax. Laterally a broad anterior straight band and another on the metepimeron both dirty carneous. Legs black.

Wings hyaline, reticulation black, costa yellow ribbed with black. All discoidal cells traversed by 2 nervures; subtriangles 6 to 7-celled in the forewings, single celled in the hind; anal loop 3-celled; anal triangle 3-celled; 1 cubital nervure in all wings; nodal index $\frac{12-21}{13-17} | \frac{21-14}{16-14}$; pterostigma of great length, narrow, black, 13 to 14 mm. long, covering 8 cells, braced; membrane very small, narrow, dirty carneous.

Abdomen very long and slender, subcylindrical, broad at base and less so towards the anal end, constricted slightly in the middle segments. Coloured black or very dark brown marked with yellow as follows;—Segment 1 with a yellow spot on each side; 2 with a fine yellow middorsal line, a transverse apical ring expanding on each side into a large yellow lateral patch which is narrowly separated from a large basal lateral spot; oreillets small, yellow, brown at the base; segment 3 with narrow basal and apical rings connected laterally by an irregular stripe of yellow; segments 4 to 7 similar but without the lateral stripes or the vestiges of one only on segment 4; segments 8 to 10 with the apical rings only. Anal appendages: superiors broad, laminate, somewhat rudder-shaped, 8.5 mm. in length by 7 mm. broad, widely separated at bases and with an obtuse-angled projection on the inner side; inferior short, 3 mm., rather broad, with a short spine terminating it on either side, concave above, convex below; both appendages blackish brown to black.

Female.—Abdomen 94 mm. Hindwing 76 mm.

Closely similar to the male, differs as follows;—Bases of hindwings rounded; abdomen broader, altogether more robust and more cylindrical; vulvar scales robust, obtuse, extending to end of abdomen, curved strongly up at apex, black; anal appendages short, pointed, black, separated by a large conical anal projection.

Distribution.—North Queensland, (very rare) Cairns, Kuranda, Atherton and Herberton during January and December. Only a single pair of this remarkable insect are known constituting the type and allotype now in the Tillyard collection. It is the largest dragonfly so far discovered, the male being 40 mm. greater in expanse than *P. gigantea*, and the female even more so. It is easily distinguished by its large size, by the restricted yellow on the frons and by the different character of the abdominal markings. The subtriangles of the forewings with 6 to 7 cells are also valuable distinguishing features.

Genus **UROPETALA** Selys (1857).

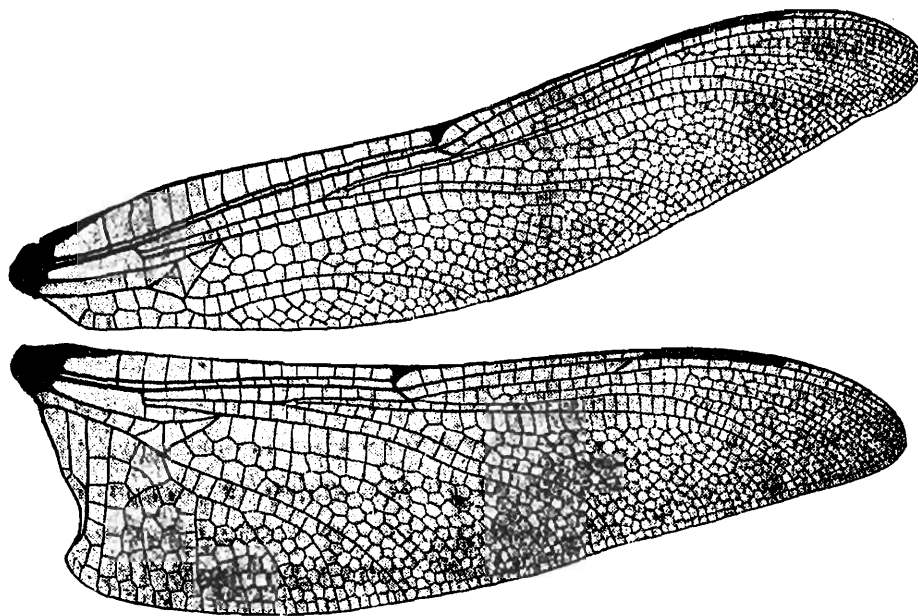
Petalura Selys, *Syn. Gomph.* p. 92 (1854).

Uropetala Selys, *Mon. Gomph.* p. 368 (1857); *Id.*, *Bull. Acad. Roy. Belg.* (2) VII, p. 551 (1859); Kirby, *Cat. Odon.* p. 82 (1890); Tillyard, *Trans. New Zealand Inst.* LIII, pp. 343-346 (1920).

Head massive; eyes widely separated, oval, markedly tumid behind; occiput large, tumid especially behind where it is grooved rather deeply; labium with lateral lobes rather larger than the medial, the latter deeply cleft, the former cordate; face deeper than broad, not overlapping the eyes; frons not elevated but projecting forwards markedly, shallowly and broadly grooved above, with a low transverse keel in front, naked; vesicle very small, depressed; antennae 5-jointed, the style made up of 3 segments.

Thorax very robust, densely clothed with long greyish hairs over the metepimeron and below. Prothorax small, very hirsute.

Legs long and robust ; hind femora with two rows of evenly sized, short, closely-set spines ; tibial spines short, robust, very closely-set, becoming abruptly smaller on the proximal fourth of limb ; claw-hooks slightly distad the centre of claws.



TEXT-FIG. 17 —Wings of *Uropetala carovei* White, ♂.

Wings hyaline, moderately broad and very long, reticulation very close, base of hindwing deeply excavate near the tornus which is almost right-angled ; membrane obsolete ; pterostigma long and narrow, situated rather far from apex, with a robust brace lying slightly proximad of its inner end ; discoidal cells dissimilar in fore-and hind-wings, that of forewing with the costal and basal sides equal and shorter than the distal, made up of 2 to 3 or rarely 4 cells by one or more traversing nervures or by three nervures meeting at its centre ; that of hindwing with costal and distal sides subequal and considerably longer than basal, made up of 2 cells, traversed once ; subtriangles of forewings usually made up of 3 cells by three nervures which meet at the centre of cell, only single-celled in the hindwing ; supratrangles usually entire but occasionally traversed once ; antenodal and postnodal nervures very numerous, the latter as numerous after the pterostigma as proximal thereof ; bridge of great length, traversed many times, the oblique nervure situated far distad ; discoidal field with 3 rows of cells to well distad of inner end of bridge ; *IA* markedly pectinate in all wings ; *Cu* very broadly arched, almost straight for a long distance from origin ; anal loop present but usually open posteriorly, made up of 3 to 7 cells ; sectors of arc arising from above middle of arc, separated at origin, diverging but slightly from origins ; 2 to 3 cubital nervures in forewing, 2 in the hind in addition to that forming base of subtriangle ; anal triangle formed of 3 cells, rarely of 4 ; basal subcostal nervure absent in all wings ; no supplemental nervures to *IR*iii ; base of hindwing in the female rounded.

Abdomen longer than wings, a little dilated at base, tapering and cylindrical thereafter ; segments 9 and 10 equal in length. Anal appendages ; superiors foliate, broadly dilated, with a keel on inner side ; inferior Gomphine-like, narrowly triangular, shorter than superiors, tapering to apex, spined above at apex and base.

Genitalia: lamina shallow, depressed, straight; anterior hamules broad complicated quadrate plates deeply sunk in the genital fissure; posterior hamules flattened, rather narrow processes strongly bevelled at apex which is acute; lobe rather small, flask-shaped.

Vulvar scales robust, extending beyond the end of segment 10, beneath which they form a massive structure somewhat like a tin-opener in shape, segments 9 and 10 much abbreviated in this sex, as also the anal appendages.

Genotype.—*Uropetala carovei* (Selys).

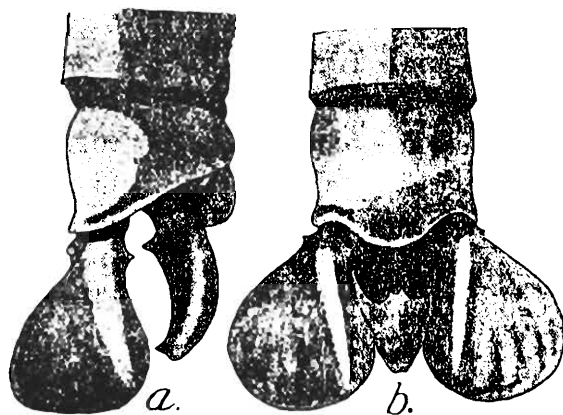
Distribution.—New Zealand only. Two species only occur, one of which appears to be restricted to the South Island. Their habits conform closely to those of *Petalura*, the larva, a massive creature, living at the bottom of deep holes or burrows in swampy situations. The genus differs from *Petalura* in having the stylet of the antennae jointed and also by the typically Gomphine character of the inferior anal appendage.

Uropetala carovei (White).

Petalura carovei, White, *Voy. Erebus and Terror, Ins.*, p. 25, tab. vi, figs. 1 and 1a (1845); Selys, *Bull. Acad. Roy. Belg.* (2) XX, p. 111 (1854).

Uropetala carovei, Selys, *Mon. Gomph.* p. 370 (1857); *Id.*, *Bull. Acad. Roy. Belg.* (2) XXVIII, p. 205 (1869); Kirby, *Cat. Odon.* p. 82 (1890); Hudson, *New Zealand Neuropt.* pp. 14-15, Pl. ii, figs. 2, 3 (1904); Tillyard, *Trans. New Zealand Inst.* LIII, pp. 343-346 (1920).

Coll. Selys, 2 ♂, 2 ♀, one of the former the type; coll. Br. Mus. 1♂, 1♀; coll. Cawthron Inst. N. Z. several of both sexes; coll. Tillyard several of both sexes; coll. Fraser. 2 ♂.



TEXT-FIG. 18.—Anal appendages of *Uropetala carovei* White, ♂. a. Right lateral view. b. Dorsal view.

Male.—Abdomen 65—67 mm. Hindwing 51 mm.

Head.—Labium brownish; labrum black, unmarked with yellow; genae yellow; ante- and post-clypeus black; frons yellowish, its lower border in front narrowly black, its base above brownish black, the black usually prolonged as a broad point into the sulcus to nearly as far as crest of frons; vertex black; occiput pale yellow; eyes dark brown.

Prothorax densely clothed with long greyish hairs, blackish brown with the posterior lobe and two circular spots on the middle lobe yellow.

Thorax blackish brown marked with pale greenish yellow as follows;—a pair of broad middorsal spots broadly separated by the blackish brown middorsal carina; the anteaular sinus which however is framed in black; laterally two oblique stripes, the anterior one, traversing the mesepimeron obliquely from above down and forwards, the posterior covering

the posterior half of metepimeron. A narrow band on the tergum uniting the first pair of stripes. Beneath thorax brownish yellow clothed with dense greyish hair.

Legs dark mahogany brown, the distal ends of femora and the whole of tibiae and tarsi black.

Wings hyaline; pterostigma reddish brown, covering 7 to 8 cells, its brace lying just proximal of its inner end; nodal index $\frac{12-16}{10-12} | \frac{19-13}{13-11} ; \frac{12-18}{13-13} | \frac{16-14}{13-12} ; \frac{15-22}{14-15} | \frac{22-14}{15-14} ;$ triangles in forewings traversed by 3 nervures which meet in the middle of cell, that of hind traversed 2 or 3 times; subtriangles traversed 2 or 3 times; 2 to 3 cubital nervures in forewings, 2 in the hind; anal loop 3 or 4 celled; anal triangle 3-celled, rarely with 4 cells.

Abdomen blackish brown or black marked with yellow as follows—a pair of large yellow spots at the base of segments 3 to 8 narrowly separated by the black dorsal crest and occupying about the basal third of each segment save 8 where the ring is much smaller and covers only the basal fourth; segment 2 obscurely yellow at base on dorsum and sides.

Anal appendages dark blackish brown; superiors with a short basal stalk after which they dilate into a broad foliate plaque which is strongly ribbed along the inner margin and irregularly crimped on the outer side of this near its free border. A small spine is seen on the middle of the inner border and a more robust one near the base. This appendage rather longer and broader than segment 10; inferior appendage about one third shorter than the superiors, narrowly triangular, tapering towards its obtuse apex above which are seen two small spines, grooved and hollowed out above and with a pair of very robust subbasal spines on its upper surface.

Female.—Abdomen 58 to 65 mm. Hindwing 57 to 61 mm.

Coloured and marked similarly to the male. The occiput finely traversed with black behind, tumid posteriorly, grooved in its lower part, a small raised tubercle on the middle of hinder border. Anal appendages very short, brown, truncate at the end; vulvar scales dark brown, very robust. Wings tinted with pale yellow at extreme base, costa finely yellow, reticulation black; neuration very similar to the male; anal loop larger, 4 to 7 cells; 2 to 3 or more rarely 4 cubital cells in forewing, 2 in the hind; nodal index variable $\frac{15-20}{15-15} | \frac{19-15}{14-15} ; \frac{13-19}{12-16} | \frac{20-14}{16-12}.$

Distribution.—Known only from New Zealand. Tillyard gives the distribution as over the whole of the North Island and Lake Wakatipu district in the South Island. Distinguished from the following species by the labrum entirely black and by the broader thoracic dorsal spots which are more widely separated. The anal appendages also are more rounded; the yellow on the frons less extensive than in *U. chiltoni* and lastly the basal black on upper surface of frons extends forwards into the sulcus as a black triangle in the male. Females are apparently more difficult to differentiate but the all black labrum will usually suffice to determine *U. carovei*.

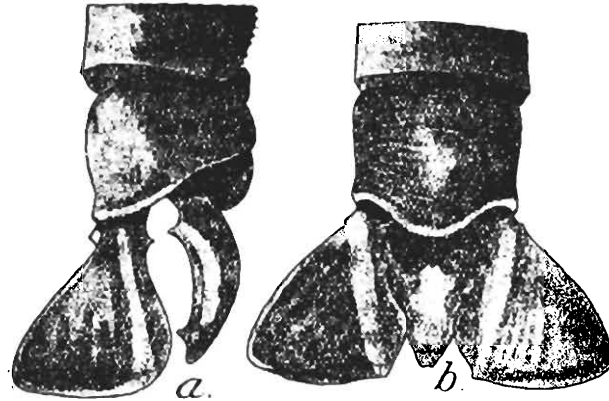
[**Uropetala chiltoni** Tillyard (1930).]

Uropetala chiltoni, Tillyard, *Trans. New Zeal. Inst.* LIII, pp. 342-346, Pl. liii, text-figs. 2a, 2b (1920).

Coll. Tillyard, several of both sexes; coll. of Cawthron Inst. N. Z., several of both sexes (including the type and allotype); coll. of Fraser, 2 ♂; coll. Br. Museum, 1 ♂, 1 ♀, Cass, New Zealand.

Male.—Abdomen 60 mm. Hindwing 47 mm.

Head.—Labium brown; labrum black with a broad yellow centre, the anterior border and sides broadly black, the base narrowly so from whence a small projection runs to nearly



TEXT-FIG. 19.—Anal appendages of *Uropetala chiltoni* Till, ♂. *a.* Right lateral view. *b.* Dorsal view.

cut the yellow centre in two; genae yellow; ante- and post-clypeus black; frons yellow with its base above brownish-black, but narrowly so and rarely extending into the sulcus; vertex black; occiput yellow; eyes dark brown, black behind but narrowly margined with yellow outwardly.

Prothorax dark brown, coated with coarse greyish hairs.

Thorax blackish brown marked with pale greenish yellow as follows;—a pair of broad dorsal spots narrowly separated from each other by the black middorsal carina, more so below than above, these spots narrower than in *U. carovei* and not extending quite to antealar sinus, the latter pale greenish yellow except anteriorly; laterally two narrow oblique parallel stripes, the anterior traversing the mesepimeron obliquely from above downwards and forwards and connected broadly across the tergum with its fellow, the posterior one covering the hinder half of metepimeron. Beneath thorax brown, densely clothed with long greyish hairs.

Legs black or the femora blackish brown. Wings hyaline, palely enfumed, reticulation black or dark brown, more open than in *U. carovei*; pterostigma very long and very narrow, covering 6 to 7 cells, reddish brown, its strong brace lying about half a cell proximal to its inner end; membrane almost obsolete, whitish; nodal index $\frac{9-19}{11-13} | \frac{18-9}{11-11} | \frac{10-15}{9-14} | \frac{17-11}{14-8}$, $\frac{11-16}{9-13} | \frac{16-10}{13-11}$; 3 to 5 cells in the anal loop; 2 to 3 cells in triangle of forewings, rarely 4, only 2 in the hind; 3 to 4 cells in the anal triangle, usually only 3; 2 to 3 cubital nervures in forewing, 1 to 2 in the hind; supratrangles usually entire but occasionally traversed once.

Abdomen black or blackish brown marked with a pair of large yellow basal dorsal spots on segments 2 to 8, narrow on segment 2 and much smaller on segment 8. Segments 1 and 2 coated with long greyish hairs but to a less extent than in *U. carovei*, and the borders of the genital fossa entirely naked. The yellow spots are larger and more closely apposed than in *U. carovei*, being almost confluent at base of segments across the middorsum; segments 9 and 10 unmarked.

Anal appendages blackish brown, superiors half as long again as segment 10, broadly foliate as in *U. carovei* but more triangular in outline; armed with small spines at the inner

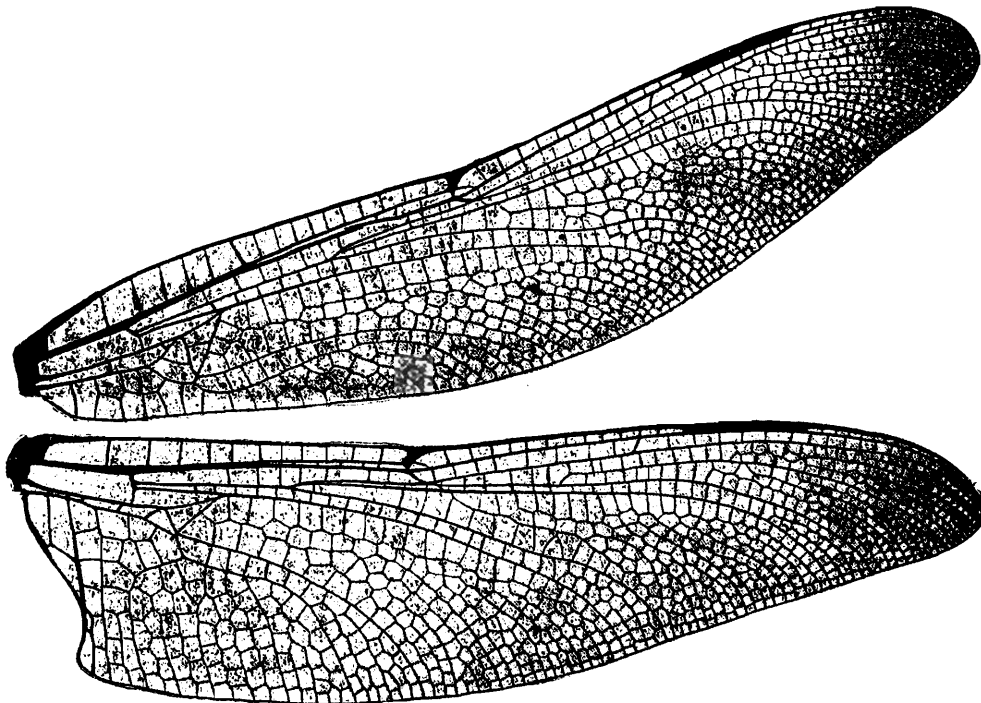
border and base as in *U. carovei*; inferior appendix similar to the latter species but narrower and more truncate.

Female.—Abdomen 62 mm. Hindwing 47 mm.

Very similar to the male, differing only in sexual characters. The upper surface of frons is generally similar to that of *U. carovei*, being more broadly marked with black at the base than in the male. The basal abdominal spots are also broader than in the male. A female in the British Museum has the subcostal nervure of forewings prolonged distad the node for one cells breadth; in the same specimen the nodal index is $\frac{10-19}{11-15} | \frac{19-12}{15-11}$; triangles in forewings 2-celled, subtriangles 2 to 3 celled, anal loop 5-celled.

Anal appendages and vulvar scales black, the former very short and separated by a conical downy process.

Distribution.—Arthur's Pass and Cass, New Zealand during January. Differs from *U. carovei* by the yellow centred labrum, the frons only narrowly black at base and the borders of the genital sac naked. The anal appendages also show some differences in shape, especially the superiors. The basal black on frons is absent in some males; the yellow on front of frons does not always overlap on to the postclypeus, as Tillyard states, but may be strictly limited by the suture between them. The reticulation of the wings of *U. chiltoni* is decidedly more open in character; in the wings of one specimen, the number of antenodal and postnodal nervures of forewings amounted to 98 as compared to 120 in a specimen of *U. carovei*. The latter insect is usually decidedly larger than *U. chiltoni*.



TEXT-FIG. 20.—Wings of *Phenes raptor* Rambur, ♂.

Genus **PHENES** Rambur (1842).

Phenes, Rambur. *Ins. Névropt.* p. 175 (1842); Selys. *Bull. Acad. Roy. Belg.* XXI (2) p. 111 (1854);
Id., *Mon. Gomph.* p. 375 (1857); Kirby, *Cat. Odon.* p. 83 (1890).

Head of moderate size, broader than deep; eyes well separated, markedly tumid behind; occiput tumid, as broad as long, the posterior border being as broad as the upper breadth

of eyes and furnished with two conical horns behind and an obtuse dorsal spine above; labium with median lobe cleft into two oval scale-like lobes each with a spine at its apex, the lateral lobes slightly larger, oval, notched, bearing a long curved spine at the inner margin of notch and a small point at the outer; face broad and deep, nearly as broad as deep, slightly overlapping the eyes laterally; vesicle very small; antennae five-jointed, basal and penultimate segments robust, distal ones very fine, rather short and three in number.

Thorax very massive, bearing a short very robust spine on each side near the antero-inferior border of mesepimeron.

Legs robust but relatively short for the size of insect; hind femora armed with two rows of closely-set, short spines, which are longer and more robust on the proximal half of limb; claw hooks situated slightly distad the middle of hooks.

Wings hyaline, very long and moderately broad, reticulation very close; base of hindwing shallowly excavate, tornus markedly angulate; membrane long but very narrow; pterostigma very long and very narrow, situated far from apex of wings, its well-developed brace lying far proximal of its inner end; subcostal nervure prolonged for about half a cell length distad the node; discoidal cells differently shaped in fore- and hind-wings, that of forewing with costal and basal sides equal, the distal side considerably longer, traversed by one nervure; that of hindwing with costal and distal sides equal and about double the length of the basal, entire; subtriangle of forewing irregularly triangular, as large as the discoidal cell, two to three-celled, usually the latter, in the hindwing much smaller and entire; supra-triangles entire or traversed once in one or more wings; antenodal and postnodal nervures numerous, the latter being more numerous distad the pterostigma than proximad thereof; bridge traversed many times; discoidal field of forewing beginning with a row of 4 cells and then continued for a short distance as rows of 2 cells, rapidly broadening to a row of 6 cells deep at level of node; the nervure *IA* pectinate, especially in the hindwing where it is strongly forked; *Cuiv* in forewing broadly and flatly arched; anal loop present but usually open below, made up of 4 to 6 cells; sectors of arc arising from centre of arc and running parallel for some distance; median space entire; 1 to 4 cubital nervures in forewing, 2 to 3 in the hind in addition to that forming base of subtrigone; anal triangle made up of 3 cells; no basal postcostal nervure present in any wing.

Abdomen long, subcylindrical, carinated, a little dilated at base and anal end; segments 9 and 10 much abbreviated in the female, the 10th very short; oreillets on segment 2 moderately large, subtriangular.

Anal appendages forcipate in the male, of great length and intricate in character; superiors shaped like the grappling tongs of an automatic dredger, L-shaped in profile and deeply hollowed out on the inner side which is thickly coated with hairs; inferior long, narrow, strongly curled up and slightly tumid at apex.

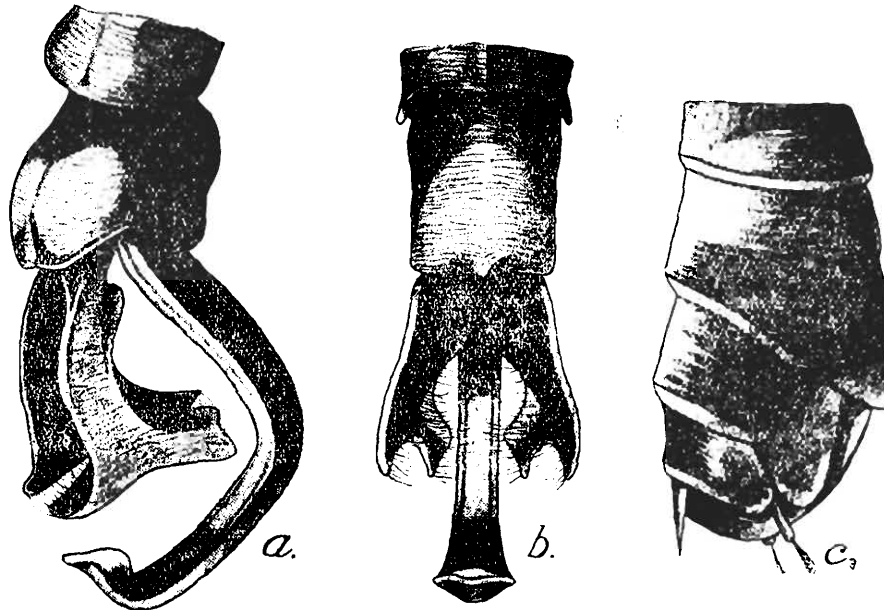
Genitalia.—Lamina deeply notched, thrown into two folds, the outer of which encloses a deep notch; hamules long and sinuous, tapering tongue-like processes, obtuse at apices; lobe scrotal-shaped. Ovipositor very short, not extending to end of abdomen.

Genotype.—*Phenes raptor* Rambur.

Distribution.—Confined to Chile. The genus is closely related to *Petalura* by the venation, the long slender pterostigma and the female genitalia.

Phenes raptor Rambur (1842).

Phenes raptor, Rambur. *Ins. Névropt.* p. 176 (1842); Gay, *Fauna Chili*, VI, p. 115, pl. i, fig. 6 (1854); Selys, *Bull. Acad. Roy. Belg.* XXI (2) p. 112 (1854); *Id.*, *Mon. Gomph.* p. 377 (1857); Kirby, *Cat. Odon.* p. 83 (1890); Schmidt, *Zool. Jahrb. Jena*, XXXIX, Ht. 1, pp. 92, 121, 133, 137, 151, 152, 159, 162, Pl. x, fig. 13 (1915).



TEXT-FIG. 21.—*a.* Anal appendages of *Phalnes raptor* Ramb., ♂. Right lateral view. *b.* The same, dorsal view. *c.* End segments and vulvar scales of same species, ♀.

Coll. Selys, 2 ♂, and 2 ♀: Paris Museum 1 ♂ and several ♀. (All from Valparaiso, Chile.)

Male.—Abdomen 65—70 mm. Hindwing 52—55 mm.

Head.—Labium pale yellow, the middle lobe finely bordered with black or entirely black; labrum, bases of mandibles, postclypeus and frons yellow; anteclypeus and lower part of postclypeus black; a narrow black line on frons which is very prominent and slightly excavate at its middle; vertex black; occiput yellow or ochreous, a prominent cone on its dorsum and two short black spines on the posterior border with numerous fine spines scattered on the surface. Eyes relatively small, posterior surface tumid, rounded, yellow changing to black against the occiput.

Prothorax black coated with fine pale hairs and with a tuft of thick grey hairs on each side.

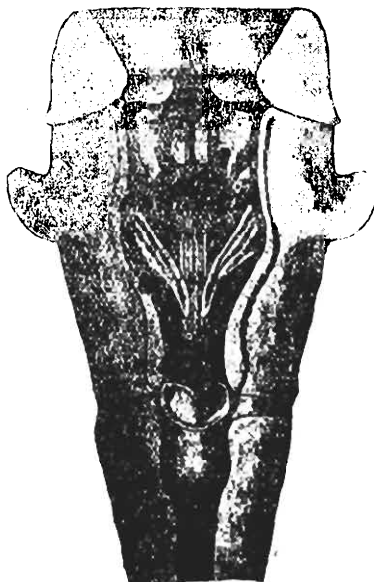
Thorax uniform pale yellow or brown with a rounded black humeral spot on each side covering the upper two thirds of the humeral suture, and two similar but smaller spots on the middles of the mes- and met-epimeron. A robust thick-set spine on the lower part of mesepimeron. Legs black; femora with yellow stripe running along each side but partly obscured by black on the anterior pair.

Wings hyaline palely tinted with amber or greenish yellow at the bases, reticulation black, costa yellow; membrane white; pterostigma black, covering 6 cells in forewing, 4 to 5 in the hind, a robust brace situated about 2 cells proximad of its inner end; nodal index slightly variable $\frac{11-15}{12-11} \mid \frac{16-11}{11-12}$; $\frac{17-18}{15-12} \mid \frac{17-16}{12-14}$; $\frac{14-16}{13-12} \mid \frac{15-14}{12-13}$; 6 to 7 rows of cells in the anal field.

Abdomen ochreous varied with black and brown as follows—segment 1 coated with grey hairs on dorsum ; segment 2 with a subapical black square dorsal spot finely divided by the yellow middorsal carina, the oreillets and a small spot behind them black ; segments 3 to 7 with the apical half black and an elongate spot of the same colour on each side ; segment 8 with the apical two thirds black ; 9 entirely so ; segment 10 pale yellow with a forked dorsal black spot on the basal two thirds which is itself marked with two yellow points. Segment 10 truncate above, the apical border slightly notched and the middorsal carina above this extended as a short obtuse spine ; segments 2 to 8 with the articular nodes black, and all from 3 to 9 bearing a small tubercle at the lateral apical angles.

Anal appendages very large ; superiors longer than segment 10, brownish black, coated with long hairs within, which is deeply hollowed out, glossy but finely corrugated on the outer surface. Seen in profile they are shaped like the figure 7 with the upper arm of the figure directed straight down at right angles to the stem as a squared plate, and sloping inwards to nearly meet its fellow on the opposite side. At the basal third, a robust rounded process. Viewed from the dorsum, the upper border slightly sinuous and prolonged as a triangular apical process from which the lower process springs. Inferior appendage much longer, black, yellow at the base where it is excavate on dorsum, slightly broadened at base, narrow with parallel sides as far as apex which is again slightly tumid and dilated. Seen in profile, it resembles a long curved hook, curving down as far as its middle, then strongly up, and at the apex rather strongly or abruptly towards the superiors which it partly envelops very similar to the appendages of some species of *Lamellogomphus*.

Female.—Abdomen 54—63 mm. Hindwing 52—60 mm.



TEXT FIG. 22.—Genitalia of *Phenes raptor* Ramb, ♂.

Closely similar to the male in colour and markings but differs as follows;—labium yellow ; labrum with two small median black points at anterior border ; base of postclypeus with two black impressions joined by a fine line ; a narrow black basal line on upper surface of frons ; occiput yellow, more conical than in the male above, the apex of the cone a little truncate and directed very slightly forwards ; the two posterior cones more discrete, more

robust and each surmounted by a tuft of short stiff hairs. Legs yellow marked with four black lines which become confluent at distal ends of femora.

Abdomen more robust, cylindrical, dark ochreous, articulations brownish black ; dorsum of segment 2 broadly black marked with a diamond-shaped yellow dorsal basal spot and two elongate spots of the same colour on each side ; segments 3 to 7 with subquadrate black spots occupying the apical third of dorsum and confluent with a lateral spot of the same colour ; segments 8 and 9 similar but without the lateral extensions and the dorsal spot extending to base of segments ; segment 10 clouded with black on dorsum.

Anal appendages brown, slightly shorter than segment 10, conical, pointed, surmounting a conical protuberance of the same colour ; vulvar scales robust, extending to end of segment 10, shaped very similarly to those of *Aeschna juncea*.

Wings palely tinted with greenish-yellow, rounded at base, membrane nearly obsolete ; anal loop smaller, made up of 4 to 5 cells, closed or open posteriorly ; nodal index as variable as in the male $\frac{18-22}{15-16} \mid \frac{21-18}{14-17} ; \frac{15-15}{13-11} \mid \frac{15-16}{10-12}$.

Distribution.—Known only from Valparaiso, Chile. Nothing is known as to its habits or the larva but these are probably analogous to those of *Uropetala* and *Petalura*.

Subfamily TACHOPTERYGINAE.

Head rather massive, Gomphine-shaped ; eyes widely separated, emarginate and tumid behind ; occiput large raised, tumid, furnished with numerous scattered minute spines ; labium with lateral lobes slightly larger than the middle which is deeply cleft ; labrum broadly and shallowly concave at its anterior border ; face deep but narrow ; frons raised to level of occiput, shallowly concave above, with a prominent ridge on its anterior surface and its crest emarginate ; vertex low ; antennae with basal joint very large, second joint short subconical, filament jointed. Prothorax with posterior lobe prominent laterally, and coated with long grey hairs.

Thorax very robust, almost naked, the middorsal carina raised into a prominent subacute spine, with or without a ventral tubercle beneath thorax. Legs robust, moderately long ; hind femora extending to apical border of segment 1, furnished with lateral rows of robust, closely-set spines, gradually increasing in length at distal end of limb where are 2 or 3 longer spines than the rest ; mid femora very similar and with the flexor surface also coated with minute spines ; claw-hooks very small, situated near middle of claws.

Wings hyaline, reticulation close, long and narrow, apices in line with hinder border of wings, base of hindwing in the male more or less excavate, rounded in the female ; membrane vestigial ; pterostigma very long and very narrow, over numerous cells, braced ; discoidal triangles of forewing 2—3 celled, costal and basal sides subequal, distal side longer, basal side sinuous ; discoidal triangles of hindwing 2-celled or entire, basal side very short, costal side slightly shorter than distal ; subtriangle of forewings 2 or 3-celled, single-celled in the hind ; supratrangles free in all wings ; discoidal field of forewings irregular, 2 to 3 rows of cells at origin ; 1 cubital nervure in forewings, 1 or 2 in the hind ; median space entire ; anal triangle 3-celled ; a vestigial loop in the hindwing of males ; *IA* pectinate, especially in the hindwing where it has from 4 to 8 branches ; *Cuii* in forewing markedly convex so that discoidal field is widely dilated at termen ; sectors of arc arising from centre or upper

part of arc and widely separated at origin ; arc slightly bent ; no basal incomplete subcostal nervure present.

Abdomen as long as or slightly longer than wings, cylindrical throughout, slightly tumid at base ; segment 9 scarcely longer than 10.

Anal appendages variable.

Genitalia : male.—Lamina depressed, very deeply fissured almost to its base ; anterior hamules broad flattened quadrate plates ; posterior hamules thin sinuous curved stilet-like organs, pointed at apices ; lobe scrotal-shaped, its apex short, spout-like with edges emarginate. Female : vulvar scale short, very robust and prominent, extending to or beyond end of abdomen, the end segments of which it displaces upwards, especially in *T. pryeri*. Remarkably similar to the vulvar scale found in the majority of the *Zygoptera*.

Distribution.—Japan and North America. Two genera are known, containing 3 species which were originally contained in the single genus *Tachopteryx* Selys. Kennedy however considers that *thoreyi* shows a higher development than either *pryeri* or *hageni* and has therefore removed the latter two species to a new genus *Tanypteryx*. Confined to the Northern hemisphere.

Key to Species of the subfamily *Tachopteryginae*.

- | | | | |
|----|---|--|--|
| 1. | { | Inferior anal appendages with a pair of robust imbricated spines situated near the base on the upper surface ; female with stylus below apex of vulvar scales 2 | |
| | | Inferior anal appendage without any spines on upper surface and with a well-developed midapical lobe ; female with stylus situated above apex of vulvar scales <i>T. hageni</i> . | |
| 2. | { | Metathorax presenting a well-developed hairy tubercle on its under side ; superior anal appendages without ventral spine ; inferior anal appendage with a small midapical projection ; female with segments 3 to 7, basad to the jugal suture, black marked only by a pair of small basal lunules <i>T. pryeri</i> . | |
| | | Metathorax with only a vestigial ventral tubercle ; superior anal appendages with a well marked ventral spine at their middle ; inferior appendage with a midapical notch ; female with segments 3 to 7, basad to the jugal suture, olivaceous marked by a small middorsal basal black spot <i>T. thoreyi</i> . | |

Genus **TACHOPTERYX** Selys (1859).

Tachopteryx, Selys, *Bull. Acad. Roy. Belg.* (2) VII, p. 551 (1859) ; Kirby, *Cat. Odon.* p. 83 (1890) ;

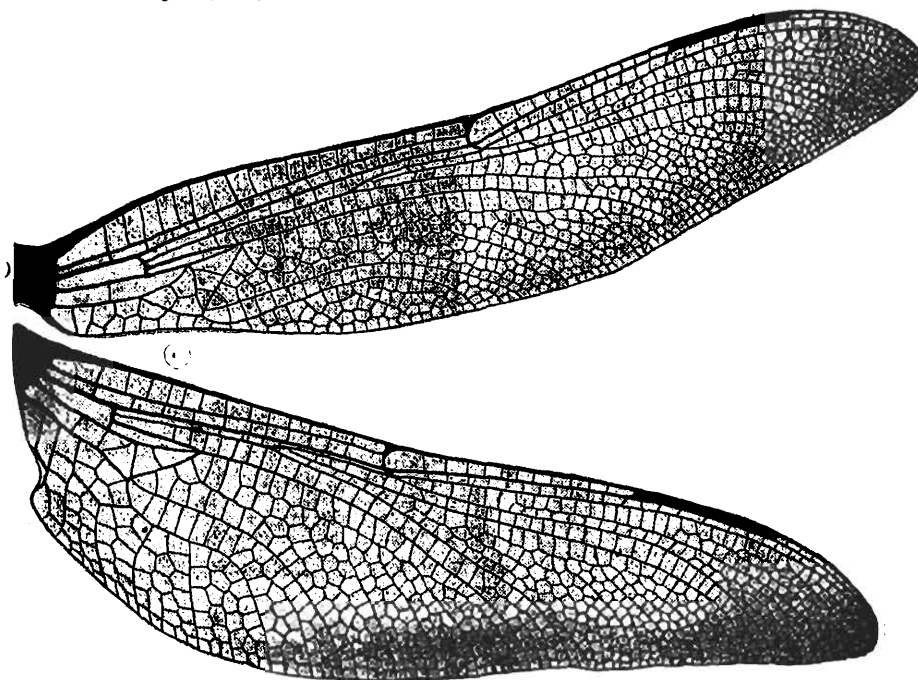
Kennedy, *Proc. U. S. Nat. Mus.* LII, pp. 507, 508 (1917).

Uropetala 2nd group, Selys, *Mon. Gomph.* p. 369 (1859).

Characters of the subfamily. Colour largely olivaceous ; thoracic ventral tubercle vestigial ; vulvar scale not quite extending to end of abdomen ; end segments of abdomen of female not noticeably displaced upwards by genitalia ; inferior anal appendage of male notched at apex and not presenting a median lobe or projection ; venation close ; the 1st and 6th or 7th the primary antenodal nervures ; anal loop made up of 5 to 7 cells ; *IA* of hindwing with 6 to 8 branches ; subtriangle of forewing 3-celled.

Distribution.—Eastern States of N. America.

Genotype.—*T. thoreyi* (Selys).



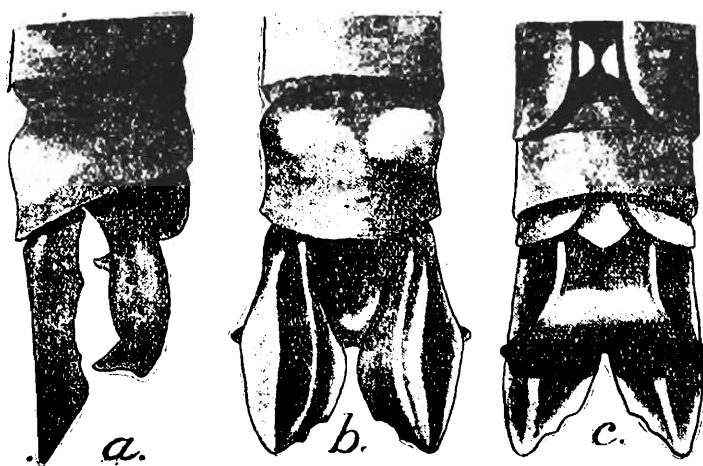
TEXT-FIG. 23.—Wings of *Tachopteryx thoreyi* Selys, ♂.

***Tachopteryx thoreyi* (Selys) (1858).**

Uropetala thoreyi, Selys, *Mon. Gomph.* p. 373 (1858).

Tachopteryx thoreyi, Selys, *Bull. Acad. Roy. Belg.* (2), VII, p. 551 (1859); *Id., ibid.*, (2), XLVI, p. 696 (1878); Kirby, *Cat. Odon.* p. 83 (1890); Will., *Ent. News*, XII, pp. 1-3 (1901); Needham, *Bull. N. Y. State Mus.* No. 47, p. 472 (1901); Kennedy, *Proc. U. S. Nat. Mus.* LII, pp. 507-515, figs. 115-123 and 130-132 (1917).

Petalura thoreyi, Hagen, *Neur. N. America*, p. 117 (1861).



TEXT-FIG. 24.—Anal appendages of *Tachopteryx thoreyi* Selys, ♂. a. Right lateral view. b. Dorsal view. c. Ventral view.

Coll. Selys, 2 ♂, 4 ♀, Kentucky and N. Carolina; coll. B. M. 2 ♂, Alleghany Mountains; coll. Williamson, several of both sexes, Alleghany Mountains; coll. Fraser, 1 pair from same locality.

Male.—Abdomen 54—58 mm. Hindwing 50—51 mm.

Head.—Labium dark olivaceous brown; labrum olivaceous with its base, anterior border and a large median basal spot black, the latter spot confluent with the basal black; anteclypeus and lower part of postclypeus blackish brown to black, the upper half of postclypeus and whole of frons save the median sulcus above light yellow, almost white, the median sulcus with a triangular basal spot blackish brown which may extend as far forwards as the crest of frons; 5 or 6 tiny black spines on each side of latter; vertex blackish brown; occiput tumid, its border broadly arched and studded over with numerous black spines similar to those on frons, pale whitish brown with a broad transverse blackish brown stripe on its crest, its hinder surface sparsely coated with long whitish hairs.

Prothorax blackish brown, its posterior lobe tumid, this part, a geminate dorsal tubercle and a large spot on either side the middle lobe palest yellow.

Thorax pale olivaceous brown peppered over with fine black granules and marked with blackish brown as follows;—the middorsal carina, a short lower outer diffuse antehumeral wedge-shaped stripe, a humeral stripe broadly overlapping each side the humeral suture, an equally broad stripe on the hinder lateral suture which extends forwards below to envelop the spiracle, finally a stripe bordering the metepimeron below. The ventral tubercle vestigial, a mere conical eminence thickly coated with long whitish hairs. Legs entirely black.

Wings hyaline; pterostigma, costa and a few of the antenodal nervures palest ochre, the pterostigma between black nervures and covering 6—9 cells, slightly longer in the hindwing; membrane vestigial in the hindwing, well-developed in the fore, pure white; nodal index $\frac{11-19}{11-12} \mid \frac{19-12}{13-11}$; $\frac{9-19}{9-12} \mid \frac{18-8}{14-9}$; $\frac{11-18}{9-13} \mid \frac{20-9}{12-10}$; $\frac{10-18}{9-13} \mid \frac{20-9}{13-9}$; anal loop 3 to 5 cells, usually 5-celled; triangle in forewing 3-celled, occasionally 2-celled, traversed by nervures which run from the basal to distal sides or from basal and costal to distal sides; 2 rows of postanal cells in forewing, 6 to 8 deep in the hind; subtriangle of forewing 3-celled.

Abdomen slightly longer than the hindwings, palest olivaceous brown marked with black and peppered with minute black tubercles or spines along the dorsum; segment 1 with its dorsum heavily coated with long whitish hairs and with a fine black oblique line on each side running from ventral border to base of segment; segment 2 with the jugal suture and apical border narrowly black, the former broadly interrupted on the dorsum, a pair of sub-basal dorsal black spots basad to jugum and a pair of larger subdorsal quadrate black sub-apical spots apicad to jugum; segment 3 similar but the paired spots fused to form a middorsal arrow-head-shaped spot on basal half of dorsum and a very large rectangular spot on apical half with its base resting on the jugal suture and its apex not quite extending to apex of segment and notched on the middorsal carina by an invasion of the ground-colour, its ventral border narrowly black; segment 4 similar to 3; segment 5 with the apico-dorsal spot confluent with the ventral black border; 6 to 8 similar to segment 5 but the confluence becoming broader and cutting the ground-colour up into an isolated lateral basal stripe; segments 9 and 10 unmarked save for a large baso-dorsal spot of the ground-colour.

Anal appendages: superiors nearly as long as segments 9 and 10 taken together, narrow and cylindrical in their basal half, broadened out and flattened in the apical and with a very thick midrib, the apices bevelled and pointed outwardly, the outer part curling abruptly up. Seen in profile a small but distinct tooth is seen situated rather nearer the base than apex of appendage. Inferior appendage about three-fourths the length of superiors, very broad

at base, then narrowing slightly at the middle and again broadening out at apex to end in lateral terminal spines which are strongly curled up to embrace the superior appendages on either side ; the apical border slightly notched at its centre. Seen in profile the upper surface of appendage presents a pair of very robust forwardly imbricated curled spines.

Genitalia : see under subfamily.

Female.—Abdomen 54—57 mm. Hindwing 50—53 mm.

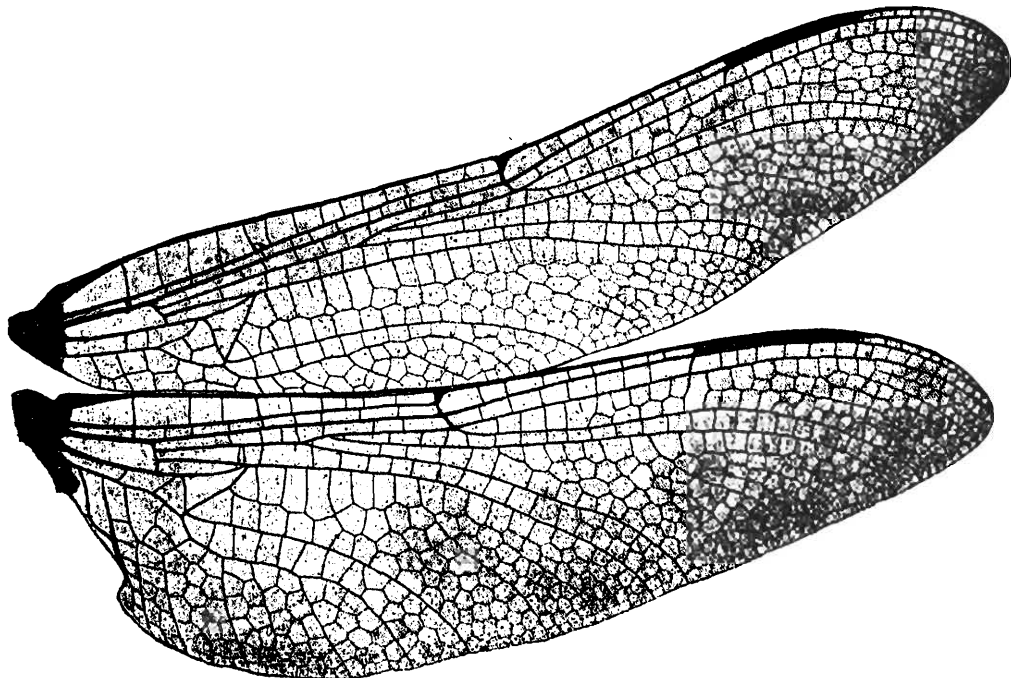
Coloured and marked similarly to the male but with the black markings more extensive, the metepimeron with its upper edge as well as lower black ; the base and dorsum of segment 1 black, the apico-dorsal spots on segments 3 to 7 covering the entire dorsum from jugal suture to apical border ; segments 9 and 10 entirely black.

Anal appendages short, conical black.

Vulvar scale not quite extending to end of abdomen, the stylus situated subapicad.

Wings hyaline ; discoidal triangle of forewings traversed once or twice but only once in hindwings ; loop variable, 5-celled, in one specimen, 6 and 7-celled in another ; the 1st and 6th or 7th the primary antenodal nervures in forewings, the 1st and 5th or 6th in the hind ; nodal index $\frac{11-16}{10-12} | \frac{17-11}{12-10} ; \frac{9-17}{8-12} | \frac{17-9}{12-9} ; \frac{11-17}{10-12} | \frac{14-9}{11-10} ; \frac{8-19}{9-11} | \frac{18-8}{12-10}$.

Larva bearing a superficial resemblance to that of *Orthetrum*, robust, head squared, the eyes small and forming sharp right-angled corners to the head, antennae primitive, 7-jointed, the joints all similar and tufted with short bristle-like hairs ; abdomen subcylindrical, fusi-form, segments 3 to 8 with postero-lateral spines ; legs robust, moderately long, the hind femora extending to 3rd segment of abdomen ; wing cases lying flat on abdomen, directed straight back and parallel to one another ; mask rectangular, flattened, without setae, middle lobe deeply fissured and minutely toothed along its convex border ; lateral lobes Aeschna-



TEXT-FIG. 25.—Wings of *Tanypteryx hageni* (Selys), ♂.

like, inner margin minutely toothed, ends quadrate, moveable hook robust but moderately short. Habits : ova are deposited in marshy soil, in small depressions filled with water such

as are left by cattle-tracks. Here the larvae develop, living in mud and bog covered by a mere film of water much as do *Gynacantha* larvae.

Distribution.—Needham gives the distribution from Massachusetts to Florida and Texas; the larva was discovered at Pittsburg, Pennsylvania; the type in the Hagen collection comes from near New York; the main centre for this insect is the Alleghany Mountains, N. E. United States; specimens in the Selysian collection are labelled,—Kentucky, in June, and North Carolina. (The abdomen of one male in the Selysian collection has been broken off and I found it stuck on to the end of a specimen of *C. diastatops*.)

Genus **TANYPTERYX** Kennedy (1917).

Tachopteryx, Selys, *pars*, *C. R. Soc. Ent. Belg.* XXII, p. lxxviii (1879); *Id.*, *ibid.*, XXXIII, p. clviii (1889); Kirby, *Cat. Odon.* p. 83 (1890).

Tanypteryx, Kennedy, *Proc. U. S. Nat. Mus.* LII, pp. 507-508 (1917).

Characters of the subfamily. Colour largely black marked with citron yellow; thoracic ventral tubercle present or vestigial; vulvar scale extending beyond end of abdomen; end segments of abdomen markedly reflected upward by genitalia; inferior anal appendage of male with a more or less marked median lobe; venation more open than in *Tachopteryx*; the 1st and 4th the primary antenodal nervures; anal loop made up of 2 to 4 cells only; *IA* of hindwing with 4 to 6 branches; subtriangle of forewings 2 or 3-celled.

Distribution.—Japan and West United States of America.

Genotype.—*T. hageni* Selys.

Tanypteryx hageni (Selys) (1879).

Tachopteryx hageni, Selys, *C. R. Soc. Ent. Belg.* XXII, p. lxxviii, (1879), Kirby, *Cat. Odon.* p. 83, (1890).

Tanypteryx hageni, Kennedy, *Proc. U. S. Nat. Mus.* LII, pp. 508-511, figs. 97-105 and 126-129 (1917).

Coll. Selys, 1 ♂ Nevada, the type, 1 ♂ and 1 ♀ Washington; coll. California Acad. Sci., 1 ♂, 1 ♀, Monroe, Washington; coll. Phil. Acad. Sci., 1 ♀ (teneral) California; coll. Mus. Comp. Zool., 1 ♂, Reno, Nevada.



TEXT-FIG. 26.—Anal appendages of *Tanypteryx hageni* Selys, ♂. a. Right lateral, b. Dorsal, and c. Ventral views.

Male.—Abdomen 43-45 mm. Hindwing 34-37 mm.

Head.—Labium pale brown; labrum glossy black; ante- and post-clypeus blackish brown; bases of mandibles citron-yellow; frons yellow, its lower part in front laterally

clouded with brown and its base above narrowly brown; vertex blackish brown; occiput blackish brown with a geminate or bilobed yellow spot posteriorly.

Prothorax dark brown with a yellow spot on each side of the posterior lobe, a geminate dorsal spot and a small lateral spot on each side of middle lobe.

Thorax blackish brown marked with citron-yellow or greeny-white as follows,—the antealar sinus yellow, an antehumeral lower dorsal triangular spot, and a second smaller spot just below antealar sinus greeny-white, laterally 2 oblique broadly interrupted yellow stripes, the first on the mesepimeron broken up into a large lower rectangular spot and a smaller upper spot, also a minute upper posthumeral point; the second stripe occupying the central part of the metepimeron and broken up into a large lower and a small upper spot. Beneath metathorax a small ventral tubercle coated with long whitish hairs.

Legs black, anterior coxae with a yellow spot; femora striped at their inner aspect with yellow for the medial two-fourths.

Wings hyaline or palely enfumed; pterostigma ochreous between black nervures, covering 4 to 5 cells, 4.5 to 5 mm. long in forewings, 5.75 to 6.5 mm. in the hind; membrane white, vestigial in the hindwing; nodal index $\frac{8-16}{9-11} | \frac{16-9}{10-9}$, $\frac{8-15}{8-9} | \frac{14-8}{10-8}$; loop 2 to 4-celled; triangle in forewings usually entire but occasionally traversed by a nervure which runs from the basal to distal sides; 2 rows of postanal cells in forewings, 5 to 6 in the hind; the 1st and 5th or 6th antenodal nervures the primaries in forewings, the 1st and 4th, 5th or 6th in the hind; subtriangle of forewings 2 or 3-celled, entire in the hind; anal triangle 3 or occasionally 4-celled.

Abdomen black marked with citron-yellow as follows;—segment 1 yellowish, its base and sometimes its apical border narrowly brown; segment 2 with the basal half mainly yellow marked with a middorsal basal diamond-shaped black spot and a lateral spot which involves most of the oreillets, the apical half black with a pair of small apical lunules, sometimes vestigial; segment 3 with a large middorsal yellow spot extending from base to jugal suture, narrowly interrupted by the black dorsal carina especially near the base where the black may extend into a diamond-shaped spot as on segment 2 (in some the yellow is invaded laterally by a tongue of black so as to convert the yellow on each side of dorsal carina into a V-shaped spot), a pair of small yellow spots on the middorsum just separated from the basal yellow and lastly a small point of yellow at apical border situated subdorsally; segments 4 to 6 very similar to 3 but the apical points very minute or absent; segment 7 similar but the middorsal paired spot confluent with the basal yellow; 8 with a large subdorsal pyriform, oblique subbasal spot; segments 9 and 10 unmarked.

Anal appendages black; superiors nearly as long as segments 9 and 10 taken together, subcylindrical and slender at base, expanded at apical half especially internally, furnished with a robust thick midrib, obtuse and squared at apex as seen from above, pointed as seen in profile and with 3 minute teeth on ventral border, one at the middle, one at apex and the third midway between these two points. Inferior appendage slightly longer than superiors, rather broad at base and of even width for basal half, then expanding rather abruptly into lateral robust spines which curl strongly upward to embrace the superior appendages as in *thoreyi*. The apical border crenulate and with a well marked midapical lobe; no dorsal spines as in the other two species.

Genitalia very similar to that of *thoreyi*, the anterior hamules curling more strongly, more rounded at their extremity, the posterior hamules less sinuous, nearly straight, the lobe scarcely differing. The oreillets very large and peppered along the free borders with minute black granules.

Female.—Abdomen 41-42 mm. Hindwing 36 mm.

Coloured similarly to the male but with the basal halves of segments 2 to 7 much more broadly yellow and enclosing a small basal black diamond-shaped spot on each segment; the small geminate spot situated middorsally just apicad to the jugal suture reproduced on all segments from 2 to 7; segments 2, 3 and 4 with small apico-lateral lunules, whilst segments 8 to 10 are entirely black.

Anal appendages short, conical, black. Vulvar scale projecting slightly beyond end of abdomen, the stylus situated on upper surface of apex.

Distribution.—California, Nevada, Washington. (Larva unknown).

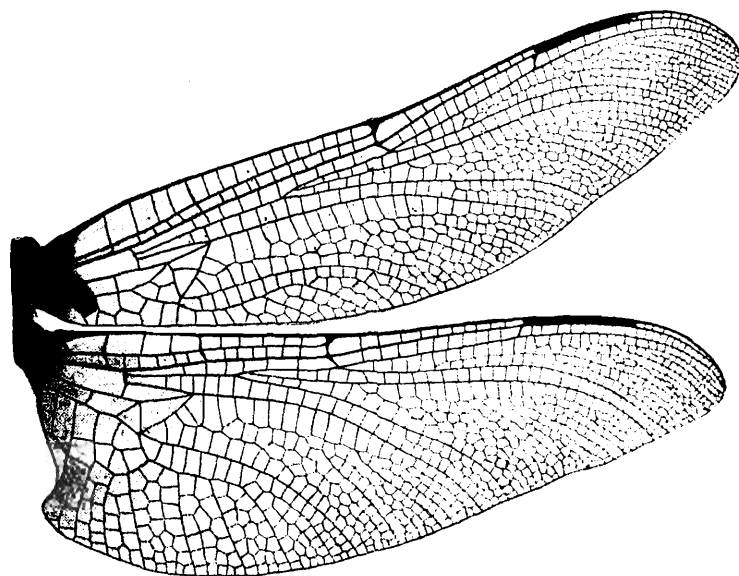
Tanypteryx pryeri (Selys) (1889).

Tachopteryx pryeri, Selys, *Bull. Acad. Roy. Belg.* (2) XXXIII, p. clviii (1889); Kirby, *Cat. Odon.* p. 83 (1890).

Tanypteryx pryeri, Kennedy, *Proc. U. S. Nat. Mus.*, LII, pp. 511-513, figs. 106-114 and 124-125 (1917).

Coll. Selys, 1 ♂, 1 ♀, Japan; coll. Phil. Acad. Sci., 2 ♂, 1 ♀, Japan; coll. Br. Mus. 1 ♂, Kobe Hills, Japan.

Male.—Abdomen 49-53 mm. Hindwing 42-43 mm.



TEXT-FIG. 27.—Wings of *Tanypteryx pryeri* Selys, ♂.

Head.—Labium black; labrum, ante and post-clypeus black; frons broadly yellow in front and above; vertex black; occiput black above, yellow behind; behind eyes black.

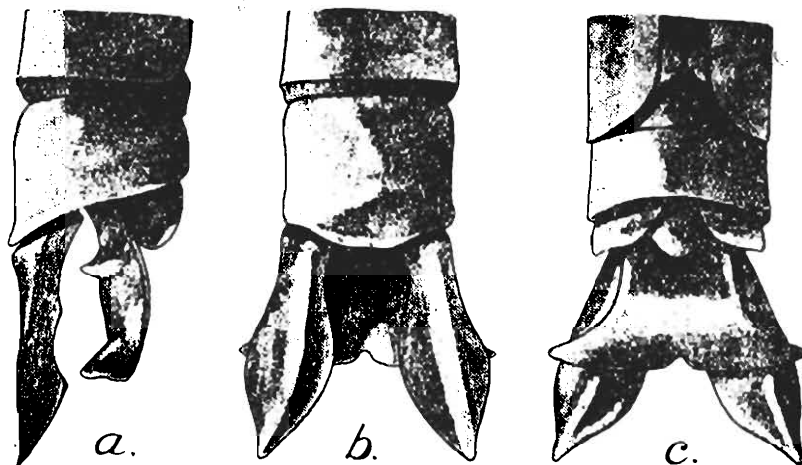
Prothorax black with an anterior yellow collar and a large oval spot on each side of posterior lobe citron-yellow.

Thorax black marked with citron-yellow as follows;—2 broad parallel dorsal stripes separated only by the black middorsal carina, the antealar sinus, a very broad lateral stripe occupying rather more than half the area between the humeral and antero-lateral sutures,

and finally the whole or the central part of the metepimeron. A large ventral metathoracic tubercle projecting prominently from beneath thorax and coated with long whitish hairs. Legs entirely black.

Wings hyaline, reticulation moderately close; pterostigma dark brown, very elongate strongly braced, covering 7 to 8 cells; base of wing less angulate than in other species, nearly straight, slightly oblique; anal triangle 3-celled; triangles of forewings traversed once by a nervure running from base to distal sides, entire in the hindwings; subtriangle of forewings 3-celled; anal loop 4 to 5-celled; the 1st and the 4th or 5th antenodal nervures the primaries in all wings; nodal index $\frac{10-15}{11-10} | \frac{15-10}{11-10}, \frac{10-15}{10-9} | \frac{16-9}{9-10}$; membrane white.

Abdomen black marked with citron-yellow as follows;—segment 1 with a small apico-lateral spot on each side; segment 2 with a hour-glass shaped mark dorsal to the oreillets and basad to the jugal suture, and a large wedge-shaped subdorsal apical spot on each side; segment 3 with a narrow basal ring interrupted by the black dorsal carina, a narrow transverse lateral spot bordering the basal side of jugum and a pair of small subdorsal apical lunules; segments 4 to 7 similar to 3 but the jugal spots missing and the basal ring interrupted on the middorsum to form two small subdorsal basal lunules; segments 8 and 9 with the apical lunules only, whilst segment 10 has one or two small vestigial dorsal spots. (In the Selysian specimens, the hour-glass shaped spots on segment 2 enclose a large mid-dorsal black diamond-shaped spot basad to jugum and are continued unbrokenly as far as the ventral border of segment; on segment 1 are seen a pair of minute subdorsal apical spots; on segment 3 the basal ring and jugal spots coalesce to enclose a large quadrate spot basad to jugum, and lastly the jugal spots are present on segments 4 and 5, although much reduced.)



TEXT-FIG. 28.—Anal appendages of *Tanypteryx pyyeri* Selys, ♂. a. Right lateral, b. Dorsal, and c. Ventral views.

Anal appendages black: superiors as long as segments 9 and 10 taken together, cylindrical at base, expanded moderately at apex which is beveled outwardly, with a robust midrib and a vestigial medial ventral tubercle not amounting to a spine; inferior appendage slightly longer than superiors, broad at base and of even width nearly as far as apical border which bears a small medial lobe. The corners of apex prolonged into robust spines which curl up to embrace the superior appendages as in the other species; a very robust dorsal sub-basal imbricated pair of spines, very similar to those seen in *T. thoreyi*.

Genitalia almost identical to that of *T. hageni*.

Female.—Abdomen 51 mm. Hindwing 47 mm.

Marked similarly to the male but with the abdominal yellow markings rather more extensive,—the apical points on segment 1, seen in the Selysian examples, very large and pronounced; the hour-glass spots on segment 2 broadened out to form lateral stripes extending from base to apex of segment and nearly to ventral border; segments 9 and 10 unmarked. Anal appendages short, conical, black.

Vulvar scale yellowish, projecting to slightly beyond end of abdomen and with the stylus situated below apex of scales. The terminal segments of abdomen are markedly reflected up by the genitalia as seen in the other species.

Distribution.—Japan. Kobe Hills. (Larva unknown.)

APPENDIX.

Since Part I of this Revision was published, a number of new species and the males of *Chlorogomphus papilio* and *xanthoptera* have been described.

I have not had the opportunity of examining any of these types save the latter, and the descriptions of most are so brief as to be of little use for purposes of comparison. It is unfortunate also that the wings of the male of *C. papilio* were not figured by Prof. Needham.

Genus **CHLOROGOMPHUS** Selys.

Chlorogomphus brevistigma Oguma.

Chlorogomphus brevistigma, Oguma, *Insecta Matsumurana*, I, No. 2, p. 86 (1926).

Female.—Abdomen 63 mm. Hindwing 57 mm.

Head black with the crest of frons, postclypeus and the labium citron yellow.

Thorax black with the narrow antehumeral stripe and three broad lateral stripes, all nearly equal in width, citron yellow. Legs black, coxae, trochanters and basal half of anterior pair of femora yellow.

Wings hyaline, saffronated at extreme base, median space traversed twice or once; discoidal triangle of hindwing wider than in *C. magnificus* and traversed by 3 nervures, the middle nervure with three arms, thus creating 5 cells.

Abdomen black, segments 1 to 8 with transverse stripe near the base; segment 1 with a pair of spots on each side; segment 2 with a middorsal stripe widening apicad, its apical ends reflected basad along each side; segment 3 with a lateral stripe on each side; segments 9 and 10 unmarked. Anal appendages small, shorter than segment 10, black. Male unknown.

Distribution.—Formosa. Male unknown. The description as it stands might well be that of *C. speciosus* or *C. preciosus*. It at least falls into this group, differing from the species mentioned by the labrum all black and segment 8 with a subbasal stripe.

Chlorogomphus brunneus Oguma.

Chlorogomphus brunneus, Oguma, *Insecta Matsumurana*, I, No. 2, pp. 87-88 (1926).

Female.—Abdomen 58 mm. Hindwing 52 mm.

Head black marked, similarly to the preceding species but the colour dark yellow ochre (Probably due to postmortem changes).

Prothorax and thorax similar to *C. brevistigma*. Legs black, marked as in *C. brevistigma*. Wings hyaline, deep burnt brown in colour, except along the hinder margin of wing and the cell middles, costal

margin and apices deeper tinted ; 2 to 3 nervures traversing the median space ; discoidal cell traversed twice in the hindwing, one nervure three armed, four-celled ; pterostigma black.

Abdomen black marked similarly to *C. brevistigma* but the yellow a deeper ochre and the stripe on segment 3 obscure.

Distribution.—Formosa. Male unknown. Wing tinting in this group is purely a manifestation of age as seen in *C. campioni*, where forms with wings quite clear in the teneral stage to old adults deeply saffronated and tinted with dark brown are found.

Allowing for this, *C. brunneus* cannot be regarded as other than a smaller very adult form of *C. brevistigma*.

***Chlorogomphus suzukii* (Oguma).**

Orogomphus suzukii, Oguma, *Insecta Matsumurana*, I, No. 2, p. 88 (1926).

Male.—Abdomen 63 mm. Hindwing 48 mm.

Head black, frons, postclypeus and labium yellow.

Prothorax and thorax black marked with citron yellow stripes exactly as for *C. brevistigma*. Legs black marked with yellow as for the latter species.

Wings hyaline ; 2 nervures traversing the median space ; discoidal cell in hindwing traversed twice ; pterostigma black ; membrane pale grey.

Abdomen black, long and slender ; segments 2 to 7 with an apical stripe as in *C. brevistigma*, (This stripe is given as near the base in the description of *C. brevistigma* but *apical* border is probably correct) but the stripe widened on segment 7, and segment 3 is without a median stripe. Anal appendages : superiors very short, shorter than segment 10, furnished with a robust tooth near apex which thus appears bifid ; inferior appendage deeply cleft, longer than superiors, each with a short tooth at apex. Female unknown.

Distribution.—Honshu, Japan. This species is probably and almost certainly the male of *C. brevistigma*, the markings being identical in all respects except for the abdominal ones which usually differ somewhat in the sexes. Tinting of the wings in this group of *Chlorogomphus* is also exclusively confined to the females. The description of this male conforms closely to that of *C. preciosus*.

***Chlorogomphus nasutus* Needham.**

Chlorogomphus nasutus, Needham, *Zool. Siniaca*, XI, p. 97, (1930).

Male.—Abdomen 74 mm. Hindwing 55 mm.

Head black, lower border of anteclypeus and postclypeus yellow as also an obscure stripe on crest of frons. Occiput black fringed with black hairs ; frons elevated, pyramidal in shape.

Thorax black with an antehumeral stripe dilated at its upper end, a humeral stripe, rather wider, the ends of these two approximating below, two broad lateral stripes on each side with two or three small spots between them, all citron yellow.

Wings hyaline, pterostigma black, 5 mm. in length. (No details of venation given.) Legs black, touched with yellow at basal segments.

Abdomen black with segments 1 to 5 marked with yellow as follows ;—segment 1 with a small lateral spot, segment 2 with a ventro-lateral spot on each side at the base and a larger apico-lateral which is produced dorsalwards at the apex of segment ; segments 3 to 6 with transverse apical spots. Segments 7 to 10 and the anal appendages black, the latter not described.

Distribution.—This insect is described as “ a fine big black species,” and the description which follows is quite worthless to serve the purpose of differentiating it from other species. It falls near *C. speciosus*. Type in the National Research Institute, C. U. No. 963. Female unknown. The dimensions given are enormous as compared with all other species except the following, and are evidently incorrect.

Chlorogomphus tunti Needham.

Chlorogomphus tunti, Needham, *Zool. Siniaca*, XI, pp. 97, 98 (1930).

Female.—Abdomen 72 mm. Hindwing 57 mm.

Head black, postclypeus and a transverse stripe across the crest of frons yellow.

Thorax black marked with a narrow antehumeral stripe on each side of dorsum which is widened above where it becomes confluent with a broad humeral stripe which is squarely truncate at both ends. In addition to these yellow stripes, a broad oblique stripe on the mesepimeron and another narrower streak of yellow on the lower border of metepimeron. Legs black, coxae, trochanters and the proximal ends of anterior pair of femora yellow.

Wings hyaline; 23 antenodal nervures and 13 postnodal nervures in forewings. (No other details of wings given by the author.)

Abdomen black marked with yellow as follows;—a broad carinal stripe extending from the apex of segment 1 to the apical border of segment 2, obscure apical lunules on segments 3 to 6, obsolete on 6, an apical ring covering the apical fourth of segment 7 with a trilobate border on both sides; remaining segments unmarked. Vulvar scales produced slightly and emarginate apically as a square notch. Male unknown.

Distribution.—A single female from Kwanhsien, now in the Cornell University collection. Type No. 956. Prof. Needham states that he was inclined to regard this species as the female of *C. nasutus* but it differs by the frons flat and the yellow apical ring on segment 7 instead of 6. Like the last species, the total length of the body has been given for that of the abdomen. The actual length is probably about 62 mm.

Chlorogomphus infuscatus Needham.

Chlorogomphus infuscatus, Needham, *Zool. Siniaca*, XI, No. 2, pp. 99, 100 (1930).

Female.—Abdomen 71 mm. Hindwing 56 mm.

Head black, postclypeus broadly traversed by a yellow band, frons with a narrow crest of yellow, labium and bases of mandibles also yellow; occiput densely clothed with black hairs posteriorly.

Thorax black with a pair of antehumeral stripes abbreviated below, broadened above and with ends divergent. A pale T-shaped mark occupying the middle of carina on dorsum, a broad humeral stripe truncate at both ends and narrowly separated from a curved spot on middle coxa. A broad yellow stripe on the middle of mesepimeron and another on the lower border of metepimeron confluent with a U-shaped yellow marking below. Legs black, coxae yellow.

Wings hyaline deeply enfumed in their basal halves and along the costal space of forewing as far as pterostigma. A clearer area invading the enfumed one as far as the arc in the forewing and as far as the bridge in the hind. In both wings a narrow hyaline area around the anal angles. ? antenodal nervures and 16 postnodal in the forewings, 18 antenodal and 17 postnodal in the hind; 2 transverse nervures in median space in all wings; supratrangles traversed 4 times; 7 cubital nervures in forewing, 6 in the hind; discoidal cell of forewing 3-celled; pterostigma black, covering 5 cells.

Abdomen black marked with yellow as follows;—segment 1 with a pair of short apical lunules and a large spot on each side; segment 2 with the middorsal carina partly, and the sides very broadly; segments 3 to 7 with the lunules more or less separated, that on 7 covering the apical third. Laterally pale with, on segment 3, a dorsal prolongation along the jugal suture. Segments 8 to 10 unmarked. Dorsum of segments 1 and 2 hairy. Male unknown.

Distribution.—A single female now in the Cornell University, Type No. 972, from Chengtu. This species appears to be closely allied to *C. auratus* Martin from Tonkin, but the latter has the wing apices blackish brown and the humeral stripe narrow. Here again, as in the case of *C. nasutus* and *C. tunti* Needham has given the total body measurements instead of the abdominal. Unless we accept this

explanation, the abdomen is out of all proportion to the rest and the wings of the insect, and the three insects are far and away larger than any other species of the genus.

Chlorogomphus xanthoptera Fraser.

Chlorogomphus xanthoptera, Fraser, *Rec. Ind. Mus.* XXXIII, Part IV, pp. 457-549 (1931).

Male.—Abdomen 55 mm. Hindwing 48 mm.

Head:—Labium pale brownish yellow; labrum blackish brown; ante-clypeus pale greenish brown or olivaceous, yellow along the superior border; postclypeus greenish yellow narrowly bordered and traversed at its middle with dark brown; rest of head black but the frons with a narrow transverse yellow stripe on its crest; eyes bottle green during life; occiput black fringed with coarse black hairs.

Prothorax black, the anterior lobe bordered narrowly with greenish yellow, and a spot of the same colour on each side of the middle lobe.

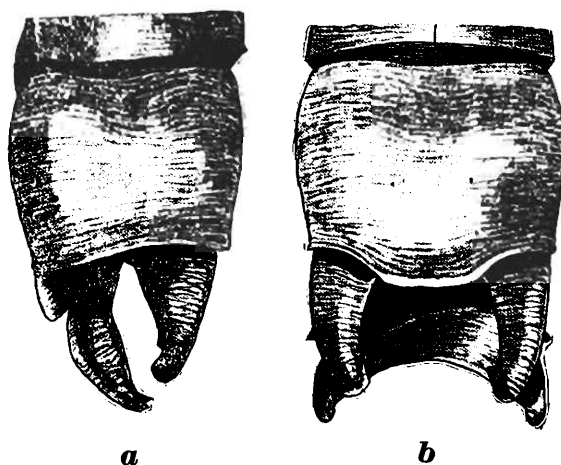
Thorax black marked with pale green as follows;—narrow antehumeral stripes and broader sinuous humeral stripes confluent squarely above; a posthumeral superior spot and two rather broad oblique stripes on each side covering the posterior halves of the mes- and met-epimeron; black beneath thorax bordered with green.

Legs black, the anterior pair of femora bright citron yellow outwardly for the proximal two-thirds.

Wings hyaline palely enfumed and with the apices tipped with dark burnt brown; pterostigma black, covering 3 to 4 cells; discoidal triangles of forewings 2 to 3-celled, that of the hind similar but the traversing nervures variable, either transverse or all three meeting at centre of cell; 1 basal incomplete ante-nodal nervure in all wings; 2 median nervures in all wings; 7 to 8 cubital nervures in forewings, 7 in the hind; 15 to 16 cells in anal loop; greatest breadth of hindwings 17 mm.; membrane cinereous; nodal

index $\frac{16-22}{16-17} | \frac{20-12}{15-13}$.

Abdomen black marked with greenish yellow as follows;—segments 1 to 3 with a lateral stripe broken only by the intersegmental joints and extending as far as the jugal suture on segment 3; segments 2 and 3 with paired spots at base and apical border; segments 4 to 7 with the paired apical spots only.



TEXT-FIG. 29.—Anal appendages of *Chlorogomphus xanthoptera* Fras., ♂. a. Dorsal view. b. Left lateral view.

Anal appendages black; superiors seen from above very broad at base, truncate at apex, keeled outwardly and curling gently in towards each other; seen in profile the apices curled gently down and a robust apical ventral spine present, the lateral keel ending in a minute apical spine. Inferior appendage slightly longer than the superiors, quadrate, its outer angles produced as upward curling spines ending in two minute teeth and deeply hollowed out on the upper side.

Female with markings very similar to the male but the head markings nearly obsolete; segments 3 and 4 have paired basal spots adjoining the jugum, the ends of these reflected on the sides towards the

base of segments. Wings coloured as in the type but the depth of the colouring varying according to the age of individual specimens.

Distribution.—Munnar, Travancore. A large colony exists on the divide eight miles to the east of Munnar and stray specimens are found on the western slopes of the watershed. Allotype in the Fraser collection, co-types in the Br. Mus., Laidlaw and Morton collections. The male closely resembles that of *C. campioni* Fras., but is much larger; the female differs much more broadly.

***Chlorogomphus olympicus* Sp. nov.**

Coll. Fraser, 1 ♂, Kufri, Simla States, 8,400 ft.

Male.—Abdomen 55 mm. Hindwing 40 mm.

Head.—Labium pale ochreous; labrum olivaceous changing to dark brown outwardly and with a minute black medio-basal point; anteclypeus greenish; postclypeus and frons bright grass-green, the former narrowly margined with blackish brown below, the latter with a narrow blackish brown stripe shaped like a cupid's-bow lying midway between the crest and lower border of frons; the base of frons above dark reddish brown; vertex and occiput black, the latter fringed with long golden hairs.

Prothorax black with a small spot on each side and the narrow posterior lobe bright yellow.

Thorax black marked with bright greenish yellow as follows;—narrow antehumeral stripes, pointed below but greatly broadened above and converging so as to be separated by only the narrow black mid-dorsal carinal suture; laterally two moderately broad stripes, one on the mesepimeron, the other covering most of the metepimeron; between these two a small but conspicuous upper spot; beneath brown marked with a mid triangle of black. Legs black, coxae pale yellow.

Wings hyaline, narrow; pterostigma black, covering 2 to 2½ cells; discoidal triangles of similar shape in fore- and hind-wings, usually entire but occasionally traversed once in the forewings; supra-triangles traversed twice, occasionally three times in the forewings; 6 to 7 cubital nervures in the forewings, 5 in the hind; 1 median nervure in all wings; a single row of cells between the origin of *IA* and *Cu₁* in the hindwing; anal triangle 3-celled; nodal index $\frac{9-18}{12-12} \frac{19-9}{14-11}$.

Abdomen much longer than wings, tumid at base, constricted at segments 3 and 4, then dilated again at base of 4 but still narrow and triquetral in section till the anal end. Coloured black marked with bright citron yellow as follows;—segment 1 clothed thickly with yellow hairs, a yellow spot on dorsum, a smaller one at each side and a narrow apical line on the sides; segment 2 with the small oreillets yellow, a pair of postjugal triangular spots narrowly separated on the dorsum, but narrowly confluent with a pair of very large apical lunules which are confluent over the dorsum, the posterior two thirds of the ventral border narrowly yellow and a prolongation from this yellow running up the margin of the segment to become confluent with the apical lunules (A large black fleur-de-lis is thus cut off and enclosed by the yellow on the dorsum of the segment); segment 3 with a pair of large apical lunules broadly confluent over the dorsum, a pair of small triangular spots lying just basad the jugal suture and separated by it from a pair of elongate triangular postjugal spots which extend nearly to the apical lunules; segments 4 and 5 with a pair of postjugal triangular spots and a pair of broadly confluent apical lunules; segments 6 and 7 with rather broad apical rings slightly indented by the black on middorsum; segments 8 to 10 with very narrow apical rings confluent below with a narrow ventro-lateral stripe, the ring on segment 10 interrupted above and subdorsally invading the black.

Anal appendages black, of equal length; superiors twisted on themselves longitudinally as seen in profile, shallowly bifid at apex, and with a robust ventral spine at mid length; gently curved towards one another as seen from above; inferior rather broadly and shallowly notched at apical border, the outer angles turned up and ending in a pair of minute spines. Female unknown.

Distribution.—A single male only is known of this species, which was taken at Kufri, Simla, at an altitude of 8,400 ft., and is now in the author's collection. The species belongs to the *atkinsoni-selysi* group and is readily distinguished by the broad extent of the abdominal markings, it being the only species of the genus in which segments 9 and 10 are marked. Other distinguishing features are the entire discoidal triangles, the bright grass-green face and the frons marked in front with a narrow sinuous black stripe shaped like a cupids-bow.

***Chlorogomphus papilio* Ris.**

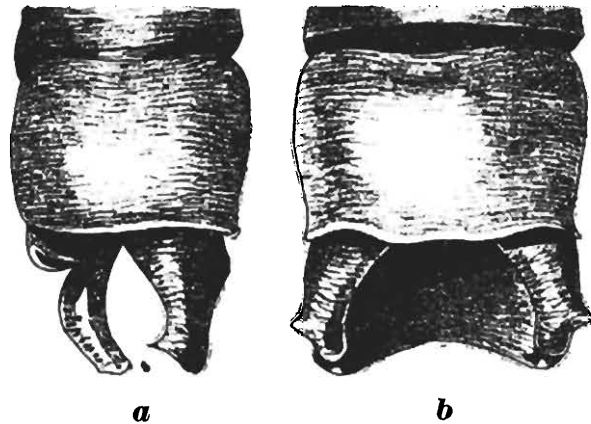
Chlorogomphus papilio, Needham, *Zool. Siniaca*, XI, No. 2, pp. 95 and 96 (1930).

Male.—Abdomen 57-59 mm. Hindwing 68-70 mm.

Head black with the postclypeus paler; a transverse yellow stripe on crest of frons and its dorsum.

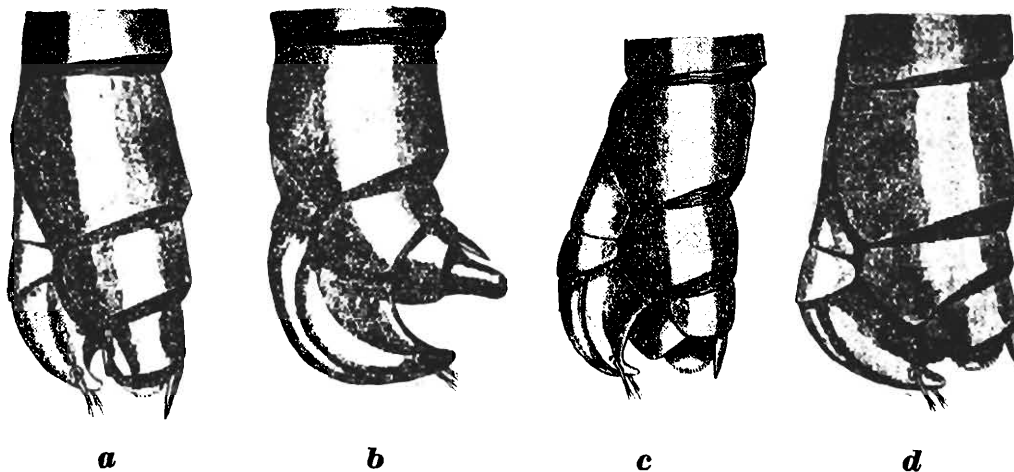
Prothorax black with a narrow anterior collar of yellow.

Thorax black marked with a pair of narrow antehumeral yellow stripes divergent below. A broad oblique median stripe on each side and vestiges of several spots behind this. Legs black.



TEXT-FIG. 30.—Anal appendages of *Chlorogomphus papilio* Ris, ♂. a. Left lateral view. b. Dorsal view.

Wings hyaline with apices tipped with black and bases coloured brown, amber and opaque sulphur yellow. Costa narrowly yellow as far out as the distal primary antenodal nervure, bases of forewings brown, the cell middles golden yellow and hyaline as far out as the discoidal triangles. Hindwing with a similar stippled pattern of brown and gold as far out as the triangle and including it, and from the hind angle of the triangle to the base of wing. A similar stippled area along the posterior border of wing as far as the end of *IA* and bounded anteriorly by the posterior border of anal loop. The area between these



TEXT-FIG. 31.—Female genitalia of a. *Tachopteryx thoreyi* Selys, b. *Tanypteryx hageni* Selys, c. *Uropetala carovei* White, and d. *Petalura gigantea* Leach.

two stippled areas, including the anal loop opaque sulphur yellow with brown network of veins. Forewing with 26 antenodal nervures, and 16 postnodal, hind with 20 antenodal and 18 postnodal; 1 or 2

transverse nervures in median space; discoidal triangle of forewing 3-celled, that of hind 2 or 3-celled; pterostigma black, covering 5 cells.

Abdomen black; segments 2 to 6 with yellow apical annules, that on segment 2 broadly dilated at base and apex of segment, and confluent with a ventral stripe on segments 2 and 3. Segments 6 to 10 unmarked.

A female in the Dahlem Museum has the dark brown areas of wings with pale cell middles, stippled, in this respect, in a similar way to the male described above. The type, a female, described in this Revision, Part I, has the brown area uniform without hyaline cell middles. A considerable amount of variation in this respect appears to exist, due to the age of individual specimens.

Distribution.—In addition to the type from Kwangtung, another male and female have since been taken in Kwangsi and are now in the Cornell University collection. The allotype male is from Si Gi Pin, Mt. Omei, Szechuen, and is now in the U. S. National Museum.

***Anotogaster myosa* Needham.**

Anotogaster myosa, Needham, *Zool. Sinica*, XI, No. 2, pp. 101, 102 (1930).

Female.—Abdomen 65 mm. Hindwing 56 mm.

Head black, labrum black with reddish anterior margin fringed with reddish hairs, and with a pair of yellow spots at the base; anteclypeus black, postclypeus yellow, black below and at middle; frons very broad and squared, black with a mere trace of a yellow stripe on the middle of crest.

Thorax black with a pair of pyriform antehumeral spots, points downward and divergent. Laterally two broad oblique stripes.

Wings hyaline, costa narrowly golden yellow on all wings, this area broadening basad to include the discoidal triangles and becoming obsolete near apex of wings. Legs black.

Abdomen black with paired yellow lunules on all segments from 2 to 8 situated at the middle of segments. Ovipositor black.

Distribution.—A single female from Yu Chi Valley, now in the Cornell University collection, Type No. 957. Needham states that it differs from other species by the broader shape of frons which is less advanced in front and more angulate at the sides. It is a blacker and more hairy species and is conspicuously different in the costal stripe in the wings, which extends as far as the pterostigma.

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