A REVISION OF THE FISSILABIOIDEA
(CORDULEGASTERIDAE, PETALIIDAE AND PETALURIDAE)
(ORDER ODONATA).
PART I.—CORDULEGASTERIDAE.

By F. C. FRASER, *Lt.-Col., I.M.S.*

(Plates IX—XII.)

PREFACE

The monographing of this part of the Odonata was entrusted to the present author in the year 1925, the work having been undertaken originally by Dr. R. J. Tillyard in 1919. Owing partly to other duties which he was then engaged upon, which more than filled up his time, and owing partly to the difficulty of examining material on the spot, situated as he was in New Zealand, he invited the present author to become joint compiler of the work. The author's return to India in the following year and Dr. Tillyard's departure for New Zealand, and later for Australia to take up his new appointment with the Commonwealth, threw unexpected difficulties in the way of this working arrangement, so that it soon became evident that either one or the other would have to shoulder the whole responsibility for the work.

As the author had already made full notes on the Selysian types and others in the European collections before leaving for India, it was agreed that he should take up the first part, the Cordulegasteridae, and that Dr. Tillyard should complete the second part, dealing with the Petaliidae and Petaluridae when leisure offered.

That so small a monograph has been spread over the long space of four years or more is explained by the fact that the author has had to do the whole of the work during his leisure hours, begging, borrowing or collecting his own material and drawing his own diagrams, with the exception of most of the wing photographs which are the fine work of a New Zealand artist, W. C. Davies, and were obtained through the agency of Dr. Tillyard.

The professional duties of a busy doctor and service-man have led to many interruptions in the work, often of several months on end, so that the threads of the argument have had to be taken up again and again and sorted out before the work could be recontinued ; under such circumstances, shortcomings were bound to come in.

This monograph aims at a continuation of those previous works which have dealt so adequately with the collections of the late Baron Edmond de Selys Longchamps, and which were arranged for by the sons of the " Father of Odonatology." The first of these monographs dealing with the order Odonata was the work of the late René Martin who dealt with the subfamily Corduliinae, published in 1906, and was followed by the monograph on the family Aeschnidae by the same author, 1908-1909. The third and last was on the subfamily Libellulinae, by Dr. F. Ris, published from 1909 to 1916. The works of René Martin, though very valuable, were quite overshadowed by the work of the latter author which is considered as one of the highest achievements of systematic entomology. The

monograph on the Calopterygidae, written also by René Martin, has been in the hands of the printers since 1914, but unhappily, the Great War has so depreciated the securities of the publishers that the funds are insufficient to permit of a continuation of the work, nor does there seem any hope in the future that further monographs will be published. Thus it has come about that the author, with great reluctance, has had to turn elsewhere for publication and that the Zoological Survey of India has undertaken the work. This has much justification as the author himself is a member of one of the Indian Services, and a large portion of the fauna dealt with in the monograph is located within Indian limits.

As far as possible, the scheme of the work has been modelled on the lines of Ris's monograph on the Libellulinae and the author has to thank his mentor for this invaluable guide. Thanks are also due to Dr. R. J. Tillyard, Mr. Kenneth Morton, Dr. F. F. Laidlaw and Mr. E. B. Williamson, all of whom have contributed by valuable advice or material, and lastly to the authorities of the British, Paris, Leyden and Vienna Museums for opportunities of examining types.

In regard to the Selysian collection, it is to be regretted that a part was lost when the P. & O. Egypt was mined and sank off Ushant, as this ship was conveying the insects to Australia for Dr. Tillyard's examination. Fortunately duplicates of some of these, especially of Indian material, have come into the possession of the author, or the loss would have been irreparable. This loss explains several hiatuses in the collection and is expressed by the names of the species being enclosed in brackets.

Perhaps in more flourishing times, the brilliant series of monographs entitled " Collections Zoologiques du Baron Edm. de Selys Longchamps " may be continued, and if so, it is the warm desire of the author that that this work may form a basis for that on the Cordulegasteridae.

Superfamily *FISSILABIOIDEA.*

The Baron Selys de Longchamps, in his *Monographie des Gomphines*, published in 1858, included under the subfamily Gomphinae a large and heterogenous group of genera possessing only a single common feature, *viz.*, the eyes more or less separated, a primitive character shared also by the whole of the Anisozygoptera and Zygoptera.

The subfamily Gomphinae he further split up into two divisions, the Integrilabiae and the Fissilabiae, according to whether the labium was simple or partially divided by a median cleft or fissure.

Modern classification has raised the Integrilabiae to full family rank under the name of Gomphidae, whilst the Fissilabiae have been left rather in the air as a number of unattached genera whose exact location has not yet been satisfactorily determined.

Selys further split up the Fissilabiae into two sub-divisions, the Nervulibasae and the Vacuibasae, according to whether the basal space was traversed or not by nervures. The discovery of larvae belonging to the former has demonstrated larval characters closely similar to those of Cordulegasterine larvae, a group of genera which belong to the Vacuibasae, so that it seems more correct to regard the Nervulibasae as belonging to the Cordulegasters, and as all of these stand far apart from the remaining genera of the Vacuibasae, and at the same time form a compact group with many common characters, the whole group is here raised to separate family rank under the name of Cordulegasteridae.

In regard to the remaining genera of the Vacuibasae, greater difficulties arise, since the relationships are by no means clear. The Petalias,—*Petalia, Phyllopetalia, Hypopetalia, Austropetalia* and *Archipetalia* show much closer relationships to the Aeschninae than to the Petaluras,—*Petalura, Uropetala, Tachopteryx, Tanypteryx* and *Phenes*, so that it seems desirable to keep them apart under a separate family heading, the Petaliidae, the remaining five genera mentioned above being included under a second family, the Petaluridae.

Selys split up the Nervulibasae into two genera, *Chlorogomphus* and *Orogomphus*, according to the shape of the discoidal cell of the hind-wings, the separation of the eyes and the ratio of the wing length to that of the abdomen, but with the discovery of new species, these differences have tended to disappear, and the two genera, especially in regard to the females (on which the generic differences were largely founded) have been found to gradually merge into one another. This being the case, it has become necessary to suppress the most modern genus *Orogomphus* (*Chlorogomphus* having priority) and to amplify the diagnosis of the latter so as to include all species. René Martin did indeed adopt this procedure when he included his species *auratus* in *Chlorogomphus*, modifying and amplifying the Selysian diagnosis to accommodate it. How far it is justifiable to alter an original diagnosis of a genus, for which a genotype has been cited, is questionable, for then the genotype cannot possibly agree with the whole of the generic diagnosis ; the diagnosis, in other words, becomes a mere catalogue of, or a description of the average characteristics of a group of insects the opposite poles of which may be very far apart.

To avoid this difficulty, the procedure adopted here has been to split up the genus *Chlorogomphus* into three groups, the first of which is named after and corresponds to *Chlorogomphus* in the strict Selysian sense, and the third to *Orogomphus*, also in the Selysian sense whilst the second or middle group forms a connecting link between the two.

Thus the arrangement adopted here is to raise the whole of the Fissilabiates to the rank of a superfamily, the Fissilabioidea, and to divide this up into three families, the Cordulegasteridae, containing the genera *Anotogaster, Allogaster, Cordulegaster* and *Chlorogomphus*, the Petaluridae containing the genera *Tachopteryx, Tanypteryx, Petalura, Uropetala* and *Phenes*, and the Petaliidae containing the genera *Petalia, Phyllopetalia, Hypopetalia, Austropetalia* and *Archipetalia*. The table given below (p. 73) shows this more comprehensively and includes all the species. This arrangement forms a very agreeable working plan with which few will quarrel, and renders the monographing of these insects a comparatively easy task.

It will be noted that the following changes have been made in the old Selysian classification,—the Fissilabiates are no longer regarded as Gomphines ; the first sub-division of these, the Nervulibasae (*Chlorogomphus* and *Orogomphus*) has been merged with the Cordulegasters, that is to say, the Selysian IV and V Legions have been united ; the Petalias have been taken out of *Cordulegaster* and raised to separate family rank, and lastly the genus *Orogomphus* has been sunk in *Chlorogomphus*.

Order ODONATA (Fabr.).

Imago.—Head with biting mouth parts ; antennae reduced, filiform ; three ocelli and two large compound eyes ; prothorax small, movable ; synthorax formed by fusion of meso- and meta-thorax, large oblique ; legs situated well forward and used mainly for alighting and cleaning, rarely for walking ; wings situated posteriorly, two equal or subequal pairs, not folded, richly veined, the subcostal vein arrested far proximad of the apex

and connected to the radius by a thick transverse nervure, the *node* ; a thick membranous *pterostigma* nearly always present between the costa and radius near the apex ; radius many branched ; *Cui* and the posterior median absent ; an *arc* and a *discoidal* cell always present ; abdomen with ten complete segments, variably shaped, the wide curved tergites enfolding and overlapping the reduced sternites ; genitalia of male on the 9th sternite, but a secondary copulatory apparatus on the 2nd and basal part of 3rd segments ; genitalia of female on the suture between the 8th and 9th sternites ; ovipositor complete or reduced.

Habits.—Carnivorous, amphibiotic, the larva aquatic, the imago aerial and breathing through two pairs of thoracic and eight pairs of abdominal spiracles, hemimetabolous, larva active, with no true resting or pupal stage but with a marked change of structure at metamorphosis.

Larva.—Aquatic, carnivorous, breathing through caudal gills or rectal tracheal gills ; eyes very large, always well separated ; labium highly specialized to form a *mask* with a hinge between mentum and submentum and provided with jaws for seizing its prey ; antennae filiform, jointed ; ocelli indistinct ; wingcases apposed or divaricate, the hind overlaying the fore.

I. Suborder ZYGOPTERA.

Fore- and hind-wings similar or closely similar ; discoidal cell four-sided ; discoidal field undifferentiated ; eyes always widely separated ; ocelli not set in a vesicle, lying free in middle of vertex ; labium with middle and lateral lobes subequal, the former deeply cleft ; male with paired superior and inferior appendages ; female with only one pair of anal appendages and a well developed ovipositor.

Larva.—Very variable in shape, always provided with caudal gills, two or three in number, one mid-dorsal springing from the 11th tergite, the others latero-ventral and springing from the 11th sternite.

Two families,—the Agrionidae and the Coenagrionidae.

II. Suborder ANISOZYGOPTERA.

Fore- and hind-wings closely similar in shape ; discoidal cell four-sided but differing in shape in fore- and hind-wings ; discoidal field present but poorly differentiated ; eyes moderately separated ; ocelli set in a well-defined vesicle ; labium with lateral and median lobes subequal, the latter cleft at its middle ; male with a pair of superior anal appendages and a single deeply cleft inferior ; female with a single pair of anal appendages and a well-developed ovipositor.

A single family,—the Epiophlebiidae.

III. Suborder ANISOPTERA.

Fore- and hind-wings different in shape, the hind expanded basad to form a broad anal field ; discoidal cell divided by a nervure into an upper narrow triangle and a lower variably shaped triangle ; discoidal field well developed ; eyes usually more or less in contact but variable in this respect ; ocelli situated in a small vesicle ; labium variable ; male with a pair of superior anal appendages and a single inferior ; female with a single pair of anal appendages and very variable ovipositor, often rudimentary.

Larva.—Very variable in shape, caudal gills always absent.

Six families,—Libellulidae, Aeschnidae, Cordulegasteridae, Gomphidae, Petaliidae and Petaluridae.

TABLE I.

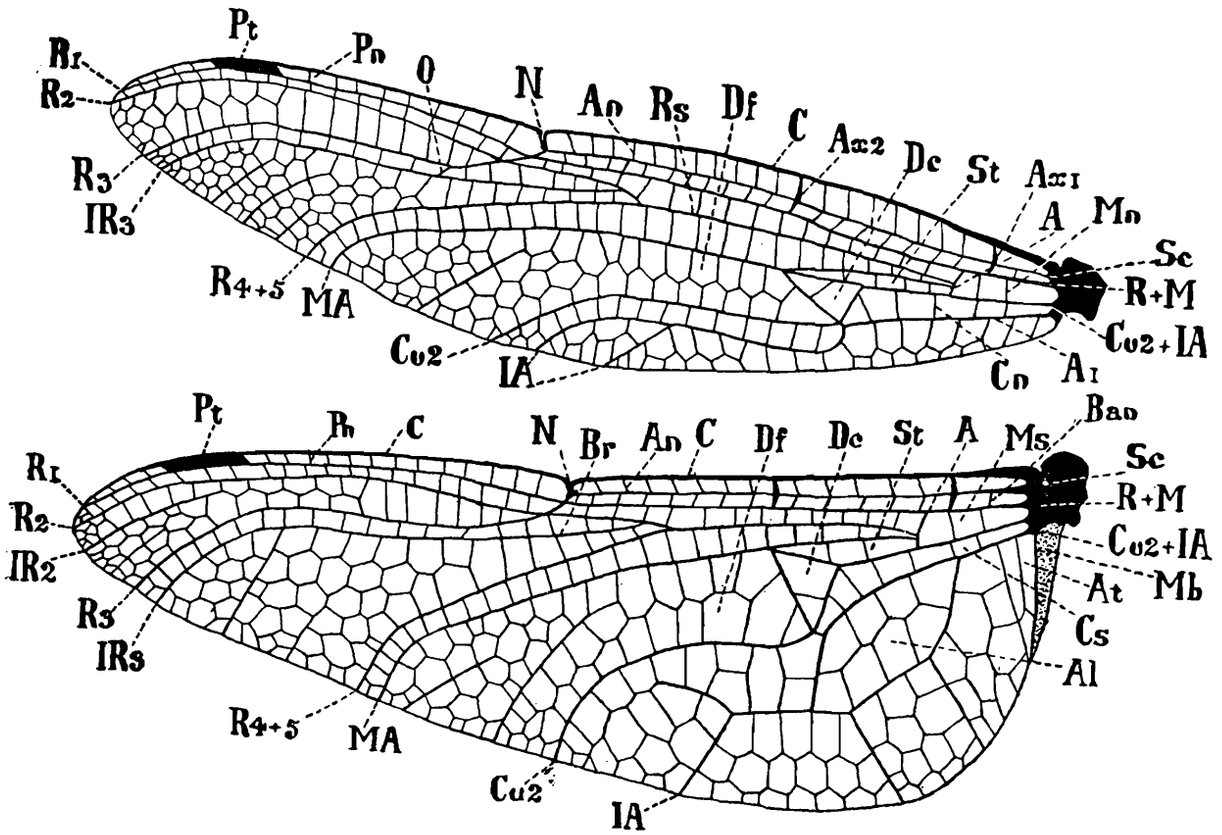
Suborder **Anisoptera**

Superfamily. **Fissilabioidea**

Family.	Subfamily.	Genus.		Species.	
Cordulegasteridae	Cordulegasterinae	*Anotogaster*			*nipalensis*, *basalis basalis*, *basalis palampurensis*, *sieboldii*, *gigantica*, *gregoryi*, *klossi*
		Allogaster		*latifrons*, *parvistigma*, *hermionae*, *annandalei*	
		Cordulegaster			*annulatus annulatus*, *annulatus immaculifrons*, *annulatus algiricus*, *annulatus princeps*, *bidentatus*, *charpentieri*, *insignis insignis*, *insignis amasinus*, *insignis nobillis*, *insignis coronatus*, *brevistigma brevistigma*, *brevistigma folia*, *luniferus luniferus*, *luniferus pekinensis*, *diastatops*, *sayi*, *maculatus*, *dorsalis*, *godmani*, *diadema*, *erroneus*, *obliqua obliqua*, *obliqua fasciatus*
		Chlorogomphus			
Petaluridae	Tachopteryginae	*Tachopteryx*	*thoreyi*, *pryeri*	*magnificus*, *papilio*, *auratus*, *xanthoptera*, *campioni*, *atkinsoni*, *selysi*, *dyak*, *speciosus*, *preciosus*, *splendidus*	
		Tanypteryx	*hageni*		
	Petalurinae	*Phenes*	*raptor*		
		Petalura	*gigantea*, *pulcherrima*, *ingentissima*		
		Uropetala		*carovei*, *chiltoni*	
Petaliidae	Petaliinae	*Petalia*	*punctata*		
		Phyllopetalia		*apollo*, *stictica*, *apicalis*, *decorata*	
		Hypopetalia	*pestilens*		
		Austropetalia	*patricia*		
		Archipetalia	*auriculata*		

TABLE II.

	Tillyard Notation.	Comstock-Needham Notation.	Selysian Name.
Costa ..	*C*	*C*	Costal nervure.
Subcosta	*SC*	*SC*	Subcostal nervure.
Radio-median	*R+M*	*R+M*	Median nervure.
Radius	*Ri*	*Ri*	Median nervure.
Arc ..	*Rs+M*	*M*	Arculus.
Radial sector	*Rs*	*Mi—iii*	Upper sector of arc.
Branches of Radius	*Rii*	*Mi*	Principal sector.
	IRii	*Mia*	Postnodal sector.
	Riii	*Mii*	Nodal sector.
	IRiii	*Rs*	Subnodal sector.
	Riv+v	*Miii*	Median sector.
Anterior Median	*MA*	*Miv*	Lower sector of arc.
First Cubitus	*Cui*	——	——
Second Cubitus	*Cuii*	*Cui*	Superior sector of triangle.
First Anal	*IA*	*Cuii*	Inferior sector of triangle.
Cubito-Anal	*Cuii+IA*	*Cu*	Submedian nervure.
Secondary Anal	*A'*	*A*	Postcostal nervure.
Pterostigma	*pt*	*st*	Pterostigma.
Membrane	*mb*	*mb*	Membranule.
Node ..	*N*	*N*	Nodus.
Subnode	*sn*	*Sn*	Subnodus.
Antenodals	*Ax (An)*	*Anq*	Antecubital nervures.
Postnodals	*Px (Pn)*	*pn*	Postcubital nervures.
Oblique vein	*O*	*o*	——
Cubital nervures or Cubito-anals	*Cux*	*Cuq*	Submedian nervures.
Bridge	*Br*	*B*	Subnodal sector at origin.
Discoidal cell	*t (Dc)*	*t*	Triangle or trigone.
(Used here to denote the triangle only, although properly speaking it represents the supratriangle and triangle.)			
Discoidal field	*d (Df)*	——	Discoidal field.
Costal space	*cs*	*c*	Costal space.
Subcostal space	*sc*	*sc*	Subcostal space.
Median space	*m (Ms)*	*m*	Median or Basal space.
Cubital space	*cu (Cs)*	*cu*	Submedian space.
Anal field	*a*	——	Base of hind-wing.
Anal loop	*al (Al)*	——	Anal loop.
Supratriangle	*s* or *ht*	*s* or *ht*	Supratriangle or Hypertrigone.
Anal triangle	*at (At)*	——	Anal triangle.



TEXT-FIG 1.

The notation employed is that of Tillyard. (For comparison with the Needham and Selysian systems see Table II.)

C.	Costa.	Mb.	Membrane.
Sc.	Subcosta.	N.	Node.
R+M.	Radio-median.	Pn.	Postnodal nervures.
Ri.	Radius.	An.	Antenodal nurveres.
A. (=Rs.+M.)	Arc.	Axi and Axii.	Primary antenodal nervures.
Rs.	Radial sector.	O.	Oblique vein.
Rii.	Branches of Radius.	Br.	Bridge.
IRii		At.	Anal triangle.
Riii.		Dc.	Discoidal cell.
IRiii		Df.	Discoidal field.
Riv+v.		Ms.	Median space.
MA.	Anterior median.	Mn.	Median nervures.
Cuii.	Second cubital nervure.	Cs.	Cubital space.
IA.	First anal nervure.	Cn.	Cubital nervures.
Ai.	Second anal nervure.	St.	Supratriangle.
Pt.	Pterostigma.	Al.	Anal loop.

Family CORDULEGASTERIDAE.

Head robust, transversely elongate ; labium as long as or longer than broad, tapered anteriorly, the apex bifid for about the apical third, lateral lobes very large, outer border rounded, inner straight or denticulate and with a long curved hook at apex ; labrum broader than long, nearly quadrangular but the angles slightly rounded ; antennae with basal joint robust short annular, second joint twice as long and a little less robust, rounded at its end, the end segment articulated or not and variable ; face projecting, quadrate or broader than

long and with the frons raised or not, sometimes higher than occiput ; eyes large, meeting at a point or more or less separated ; vesicle small or absent ; occiput small, variably shaped, with tumid posterior border or raised as a horn, variable in the sexes.

Prothorax very small, entirely hidden by the head. Thorax robust or moderately so. Legs robust, short or long, femora cylindrical, flattened below and furnished with two rows of small teeth variably shaped in the genera, tibiae with four well marked longitudinal ridges and two rows of variable spines, long or short, or with a membranous keel. Tarsal hooks robust, situated about the middle of claws.

Wings variably shaped, the hind usually broader than the fore, often considerably so, their base angulate or rounded according to genera and sexes, hyaline, coloured or not ; node situated nearly at centre of wing ; arc angulated or not ; median space traversed or not ; an incomplete basal antenodal nervure present or not ; basal space traversed or not, usually not ; discoidal cell variably shaped and occasionally differently shaped in fore- and hind-wings ; anal loop present in hind-wings, variably shaped ; anal triangle present or not ; antenodal nervures numerous, the first or second and the eighth to the tenth the primaries ; pterostigma variable, short or long ; membrane small or moderately large.

Abdomen cylindrical in one or both sexes or compressed in the female, usually tumid at base but variable at apex or anal end, as long as wings or much longer, more rarely shorter than wings in the female.

Genitalia.—Male : oreillets present or absent ; genital parts entirely hidden as viewed in profile ; lamina depressed, arched, notched or quadrate and bossed on surface ; anterior hamules variable, shaped as a complex scale-like organ or as a curved tooth ; posterior hamules of the same size or larger, triquetral, the apex curved, straight or cleft ; lobe of penis scrotal-shaped, lipped and with a raised border, more or less shallowly notched at apex ; penis with a robust tooth.

Female : ovipositor very variable, short or almost obsolete, or of extraordinary length.

Anal appendages very variable in the genera but very similar in the species of individual genera, usually equal in length to segment 10 of abdomen, the superiors triquetral or compressed and straight or slightly curved, pointed at apex and furnished below with one or two teeth ; inferior appendage variably shaped, usually shorter than superiors, quadrate, notched or not at apex.

Distribution.—Cosmopolitan except for the smaller islands and for the greater part of the African continent. (Only a single genus so far reported from Africa, which is restricted to the hills of the north west of the continent.)

Key to Genera.

1	Basal space traversed by one or more nervures ; tibiae of male keeled ; ovipositor of female greatly reduced	*Chlorogomphus.*
	Basal space entire ; tibiae of male not keeled ; ovipositor of female enormously produced	2
2	Hind-wing of male rounded ; anal triangle absent ; oreillets absent..	*Anotogaster.*
	Hind-wing of male angulate at base ; anal triangle present ; oreillets present	3

3 { Frons markedly raised, usually above the level of occiput ; face very broad .. .. *Allogaster.*
Frons not raised, not as high as occiput ; face about as broad as long .. .. *Cordulegaster.*

Genus **ALLOGASTER** (Selys 1878).

Allogaster, Selys, *Bull. Acad. Belg.* (2) XLVI, p. 684 (1878) ; Kirby, *Cat. Odon.* p. 79 (1890) ; Williamson, *Proc. U. S. Nat. Mus.* XXXIII, p. 276 (1907) ; Fraser, *Journ. Bombay Nat. Hist. Soc.* XXIX, p. 37 (1923) ; *Id.*, *Rec. Ind. Mus.* XXIX, p. 76 (1927).

Head massive ; eyes meeting at a point only, not tumid behind ; occiput small, very slightly raised ; labium with lateral and medial lobes equal, the latter cordate, cleft, slightly notched medially ; labrum very slightly notched or shallowly excavate along the anterior margin ; face very broad, nearly as broad as deep and largely concealing the eyes which it markedly overlaps ; frons very high, higher than occiput, broader than postclypeus, fringed above with long coarse hairs which project both forwards and backwards ; a similar fringe of hairs completely surrounding circumference of face ; vesicle very small, concealed by the raised frons ; antennae five-jointed, similar to family type.

Thorax robust, rather less so than in *Cordulegaster*, markedly hirsute.

Legs robust, relatively short, hind femora extending only as far as hinder border of thorax, and with armature similar to that of *Cordulegaster ;* tibiae similar to latter genus.

Wings hyaline, enfumed or coloured in the female, moderately broad and long, reticulation very close, base of hind-wing shallowly excavate, tornus markedly angulate, membrane very small and narrow ; pterostigma long and narrow, especially in the hind-wing, unbraced ; discoidal cells similarly shaped in fore- and hind-wings, costal and distal sides subequal, basal side a little more than half the length of costal, traversed once in all wings ; subtriangles traversed once in all wings ; antenodal and postnodal nervures numerous ; bridge traversed many times ; discoidal field with 2 rows of cells to well beyond level of inner end of bridge ; *IA* in all wings markedly pectinate, especially in the fore ; *Cuii* in fore-wing almost straight, so that discoidal field scarcely dilated at the wing margin ; a small but well-developed loop in the hind-wing ; sectors of arc arising at centre of arc, separated at origin, diverging slightly thereafter ; 1 to 3 cubital nervures in the fore-wing, 1 to 2 in the hind, in addition to that forming base of subtriangle ; anal triangle formed of 3 to 4 cells ; supratriangles free or traversed in all wings, usually free in the fore-wings ; basal subcostal nervure absent in all wings ; a well-defined supplemental nervure to *IRiii* in all wings. In the female, the triangle of fore-wings formed of 3 cells, shorter than those of hind-wings, the base longer and the shape more nearly equilateral.

Abdomen and genitalia shaped as in *Cordulegaster annulatus*. Anal appendages very similar to those of *Cordulegaster bidentatus*, the superiors with 2 ventral spines. Ovipositor long, at least 3 times the length of segment 10.

Genotype.—*Allogaster latifrons* Selys.

Distribution.—The N. E. Himalayas. So far known only from Tibet, Sikkim, Yunnan and North Bengal. Habits similar to those of *Cordulegaster* but exists at a much greater altitude, often exceeding 11,000 ft.

Key to species of *Allogaster*.

1	Four yellow spots on dorsum of segment 2	2
	A single saddle-shaped spot and a pair of yellow apical lunules on dorsum of segment 2	3
2	Labrum bright citron yellow narrowly bordered with black ..	*annandalei*.
	Labrum uniform dark reddish brown	*latifrons*.
3	Large species with abdomen 50 mm. in length, hind-wing 40 mm.; anal triangle 3-celled; segments 9 and 10 marked with yellow ..	*parvistigma*.
	Smaller species with abdomen 44 mm. in length, hind-wing 35 mm.; anal triangle 4-celled; segments 9 and 10 unmarked ..	*hermionae*.

Allogaster latifrons Selys (1878).

Allogaster latifrons, Selys, *Bull. Acad. Belg.* (2) XLVI, p. 684 (1878); Williamson, *Proc. U.S. Nat. Mus.* XXXIII, p. 276 (1907); Fraser, *Journ. Bombay Nat. Hist. Soc.* XXIX, p. 37 (1923); *Id.*, *Rec. Ind. Mus.* XXIX, pp. 77, 78 (1927).

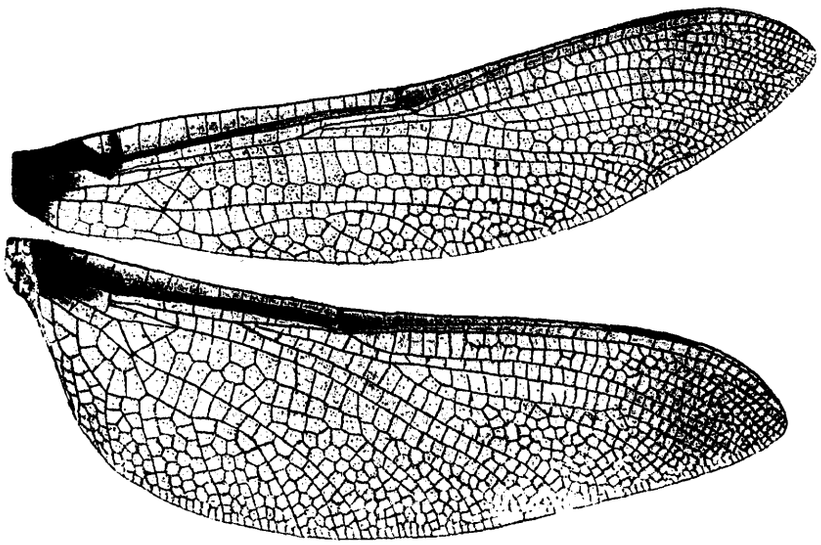
Coll. Selys, 1♀, the type; Coll. Br. Mus. 1♀; Coll. Darjeeling Mus. 1♀; Coll. Fraser, 1♂ 1♀. All from the N. E. Himalayas.

Male.—Abdomen 52 mm. Hind-wing 40 mm.

Head.—Labium dull ochreous, labrum, face and frons uniform dark reddish brown, the base of the latter above, blackish; vesicle and occiput blackish brown, the latter bright citron yellow behind and fringed with long coarse black hairs. A dense fringe of similar hairs margining the circumference of face, especially at the sides. Eyes green, dark ochreous behind with a narrow bordering of black above.

Prothorax black with a narrow collar of bright citron yellow on the posterior lobe, slightly interrupted above.

Thorax warm reddish brown clouded with black and marked with bright citron yellow as follows,—the dorsum clouded with black in its upper half and marked with vestigial upper



TEXT-FIG. 2.—Wings of *Allogaster latifrons* Selys, ♀, from type in the Selysian collection. (W. C. Davies photo.)

antehumeral citron yellow spots shaped as for the upper part of the cuneiform spots found in most species of *Cordulegaster*. Laterally 2 narrow bright citron yellow stripes, one posthu-

meral, the other over centre of metepimeron, and both heavily bordered with black in front and behind. The coxae and trochanters of the anterior pair of legs also citron yellow.

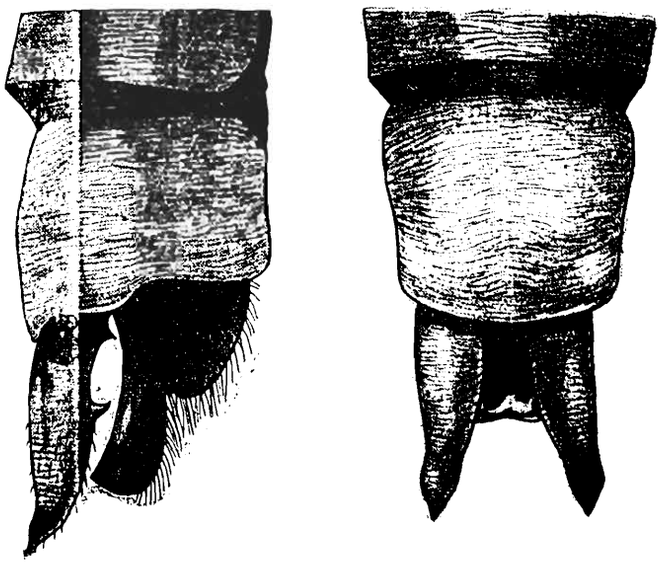
Legs black, the femora dark reddish brown changing distally to black.

Wings hyaline, the extreme bases of all saffronated. Reticulation very close ; pterostigma narrow, 3 mm. long in fore-wings, 3·5 mm. in the hind, dark reddish brown between black nervures, over 4 to 5 cells ; 3 cubital nervures in fore-wings, 2 in the hind including that which forms base of subtrigone ; all discoidal cells traversed once ; nodal index—$\frac{14-18}{15-15} \Big| \frac{18-15}{14-13}$; membrane greyish white, very narrow ; loop 15 cells ; anal triangle 4-celled.

Abdomen black on dorsum, reddish brown on sides and beneath, marked with citron yellow as follows :—segment 1 reddish brown, unmarked, segment 2 with two small dorsal lunules on the apical side of jugal suture, and two longer narrower apical lunules at the apical border, segments 3 to 8 with small triangular paired dorsal spots replacing the dorsal lunules, and segments 3 to 6 with small apical lunules, represented on segment 7 by a tiny point only. Segment 9 unmarked, 10 with two small apical dorsal spots.

Anal appendages black. Superiors compressed, the apex pointed and slightly twisted so as to lie in a different plane to the rest of the appendage. Armed with a median ventral robust tooth and another similar one beneath the extreme base of appendage. Inferior quadrate, its apex slightly emarginate and very shallowly excavate, hollowed out above, nearly one-third shorter than the superiors.

Genitalia.—Lamina depressed, coated with long hairs ; anterior hamules broad and foliate, the apices curling in towards the middle line ; posterior hamules long stilette-shaped



TEXT-FIG. 3.—Anal appendages of *Allogaster latifrons* Selys, ♂, from Allotype in Fraser collection.

organs, ending in a blunt apex, directed obliquely towards each other and meeting over dorsum of penis ; lobe short, broad, scrotal-shaped, the apex slightly bifid and excavate.

Female.—Abdomen 49 mm. Hind-wing 44 mm. (8·5 mm. broad.)

Head, prothorax and thorax as for male, the antehumeral cuneiform spots very small or altogether missing.

Wings hyaline, variably tinted for the greater part with ochreous, or more commonly the outer three-fourths of fore-wings and four-fifths of hind clouded with blackish brown. (In one female, which appears to be slightly teneral, the wings are uncoloured.) The bases and costal border as far as apex also tinted with saffron. Discoidal cell of fore-wings 3-celled ; supratriangles of fore-wings entire, those of hind traversed once ; pterostigma 5 to 6 mm. long ; membrane white, broader than in the male ; nodal index $\frac{16-18}{16-14}\Big|\frac{17-15}{15-15}$; cubital nervures 2 in all wings, in addition to that forming the subtriangle ; loop 7 to 9 cells. (The discoidal cell in the right fore-wing of type is only 2-celled and the supratriangles of hind- and fore-wings are all traversed once.)

Abdomen markedly compressed, marked as for male, the spots rather smaller. The oreillets on segment 2 and a dorsal tubercle on segment 1 thickly coated with long whitish hairs. Segment 9 with an obscure basal yellow linear stripe on each side, 10 unmarked.

Anal appendages black, very short, pointed, separated by a villous conical protuberance. Vulvar scale 7 mm. long, reddish brown, tipped with black, overlapping the end of abdomen.

Distribution.—Type from Phulloth, Sikkim, 10,000 ft. One female is from Tongloo, Darjeeling district, Bengal, and was taken at the beginning of August. A pair was taken on the Tibetan-Sikkim frontier at Nathui La and a fifth, a female, from the same locality as the type.

Allogaster hermionae Fraser (1927).

Allogaster hermionae, Fraser, *Rec. Ind. Mus.* XXIX, pp. 76 and 77 (1927).

Coll. Darjeeling Museum, 1♂ ; Coll. Fraser, 1♂.

Male.—Abdomen 44 mm. Hind-wing 35 mm.

Head.—Labium deep ochreous ; labrum, face and frons uniform dark reddish brown ; upper surface of frons and occiput dark brown ; eyes greenish during life. Face broad, largely obscuring the eyes ; frons projecting, as in *A. latifrons*, higher than occiput, fringed with long coarse black hairs which project both forward and backward. Occiput with a similar fringe projecting straight back.

Prothorax dark reddish brown, unmarked.

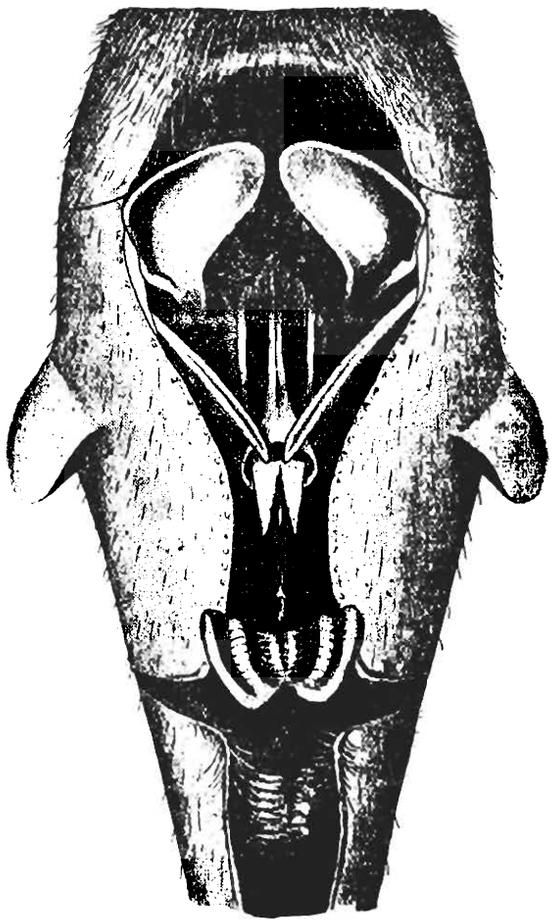
Thorax warm reddish brown marked with bright citron yellow or greenish yellow as follows :—an antehumeral cuneiform pyriform spot on the upper half of dorsum on each side, a narrow posthumeral stripe and a shorter broader one on the middle of metepimeron, both heavily framed in black.

Legs dark reddish brown, tibiae and tarsi black. Armature as for *Cordulegaster*.

Wings hyaline, reticulation very close ; pterostigma reddish brown between black nervures, very narrow, unbraced, 2·45 mm. long in the fore-wings, 3·25 in the hind, covering 3 cells ; 3 to 4 cubital nervures in fore-wings, only 2 in the hind ; 4 cells in anal triangle ; 6 cells in loop ; nodal index, $\frac{12-18}{13-13}\Big|\frac{18-13}{14-14}$; all discoidal cells traversed once. Membrane pale dirty white.

Abdomen reddish brown marked with bright citron yellow as follows :—segment 1 unmarked, pale ; segment 2 with a middorsal saddle-shaped marking which is bifid on its apical border, and limited basad by the jugal suture, except for a small medial triangular prolongation ; segment 3 with 2 large dorsal triangular spots finely separated by the ground

colour ; segments 4 to 8 with similar dorsal spots which decrease gradually in size as traced analwards ; segments 2 and 3 with additional apical dorsal lunules ; rest of abdomen unmarked.



TEXT-FIG. 4.—Genitalia of *Allogaster hermionae* Fraser, ♂.

Anal appendages reddish brown. Superiors as long as segment 10, narrow at base, pointed at apex, armed with a robust basal ventral spine and a second, less robust spine, situated slightly basad of the middle of appendage. Inferior appendage shorter than superiors, blunt at apex, shallowly notched, hollowed out above, curling slightly up towards superiors.

Genitalia.—Lamina depressed, its border emarginate ; anterior hamules foliate, thin quadrate plates strongly curled inward ; posterior hamules broad blunt spines, directed obliquely hindwards ; lobe tongue-shaped, shallowly notched at apex and hollowed out above.

Distribution.—Darjeeling district, near Mungpoo, in July, about 4,000 ft. Differs from *latifrons* by its much smaller size, it is in fact the smallest species of the family. The greater extent of the thoracic markings, as also the different character of those of the abdomen, also serve to separate the two species.

Allogaster parvistigma (Selys 1873).

Thecagaster parvistigma, Selys, *Bull. Acad. Belg.* (2), XXXVI, p. 508 (1873) ; Kirby, *Cat. Odon.* p. 79, (1890) ; Williamson, *Proc. U. S. Nat. Mus.* XXXIII, p. 277 (1907).

Cordulegaster parvistigma, Selys, *Ann. Soc. Ent. Belg.* (*Causeries Odonatologiques*), p. 181 (1894); Fraser, *Journ. Bombay Nat. Hist. Soc.* XXIX, pp. 42-43 (1923).

Coll. British Museum 1♂, (Type) Himalayas; coll. Indian Museum 1♂, Bhaji, Simla States; coll. Fraser, 1♂, Simla.

Male.—Abdomen 50 mm. Hind-wing 40 mm.

Head.—Labium, labrum, face and frons brownish yellow or reddish yellow, unmarked; a fringe of coarse hairs directed forwards and backwards on frons; occiput yellow, especially behind, fringed with long coarse hair; eyes olivaceous.

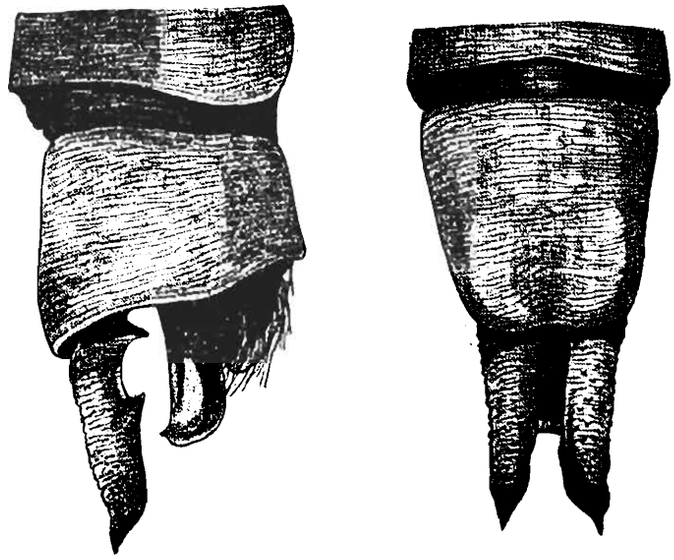
Prothorax light brown.

Thorax dark reddish brown marked with bright greenish yellow as follows:—antehumeral elongate spots, somewhat pyriform in shape, with pointed end directed down and out, and shorter than the corresponding spots seen in *C. brevistigma*. Laterally two oblique stripes, narrow, edged with black, one just posterior to first lateral suture, the other in centre of metepimeron; between them an upper and lower spot as in *C. brevistigma*.

Legs black marked with yellow on outer sides of femora.

Wings hyaline, reticulation closer than in *C. brevistigma*; pterostigma light brown, short, unbraced, over about 3 cells; cubital nervures 2 in fore-wing, 1 in the hind (not counting the one forming base of subtriangle); supratrigones entire or rarely traversed once in fore-wings, entire or traversed once in the hind (traversed once in the type); discoidal cells usually traversed once, occasionally entire; nodal index, $\frac{13-16}{13-12}\Big|\frac{16-12}{12-15}$; $\frac{14-17}{16-12}\Big|\frac{16-13}{12-15}$; $\frac{12-18}{13-14}\Big|\frac{17-12}{15-14}$; loop 3 to 5 cells; anal triangle 3-celled; membrane greyish white.

Abdomen black on dorsum, reddish brown on sides of segments 1 and 2, and basal end of 3, and of all beneath. Marked with bright citron yellow as follows:—segment 1



TEXT-FIG. 5.—Anal appendages of *Allogaster parvistigma* (Selys) ♂. From type in the British Museum collection.

bright ochreous, unmarked; segment 2 with the poorly developed oreillets, two small apicodorsal lunules and a saddle-shaped mark on dorsum bordering the jugal suture apicad, deeply notched behind, the two points on either side sometimes considerably produced (this marking rather variable); segments 3 to 8 with paired dorsal spots situate nearer base of segments than apical border, usually confluent over dorsum but often narrowly divided by the black dorsal carina; in addition, a pair of apical lunules which are usually obsolete on segments

6 to 8 but are very evident in the type, even on segment 8 ; markings on 9 and 10 very variable,—in the type, segment 9 with a subdorsal stripe confluent with a narrow basal annule, forming a sort of figure 7, in other specimens only the basal ring present ; segment 10, in the type, with a broad lateral stripe pointed behind ; in another specimen, two small middorsal basal spots and a small reniform latero-apical spot on each side, whilst in a third, there are two reniform subdorsal basal spots with their backs apposed and two curved elongate latero-apical spots converging on the apex of segment.

Anal appendages. Superiors black, inferior brown. Superiors seen from above, pointed at apex, inner border rather sinuous, surface finely stippled with black points, coarsely hairy within, spines not visible ; seen from the side, in profile, upper border level but curving slightly up at extreme apex which is acute, a robust spine at extreme base and a median ventral robust spine with a deep excavation separating it from the basal spine. Inferior appendage about three-fourths the length, sides converging slightly, apex narrowly and shallowly notched, armed with a small spine on each side at apex.

Genitalia scarcely differing in any noticeable features from *latifrons.*

Female unknown. (The type in the British Museum, described by Selys, turns out to be a male. It certainly looks like a female when casually examined, which may account for Selys error. I have not seen a female of this insect which is probably very similar to that of *latifrons.*)

Distribution.—The type is from the Himalayas, collected by Mr. Moore ; a male in the Indian Museum is from Bhaji, Simla Hill States, 8,800 ft., and was collected by Mrs. Kemp, x. 21. I have a single male from Simla collected by Mr. Rishworth. It appears to keep to a higher altitude than *C. brevistigma* which is common around Simla at altitudes of under 7,000 ft., whilst *parvistigma* is apparently rare under 9,000 ft.

The ground colour, and more especially the very lofty frons, at once places this insect in the genus *Allogaster.* The distinction is very apparent when the insect is confronted with a *Cordulegaster.* I find a note, in my manuscript, made some years ago, stating that the type looks very like an *Allogaster ;* a closer study of the type has confirmed this opinion.

[**Allogaster annandalei** (Fraser 1923).]

Anotogaster annandalei, Fraser, *Journ. Asiat. Soc. Bengal* (n. s.) XIX, No. 9, pp. 451-453, fig. i (1923).

A single ♂ from West of Pungtzula, Yunnan, Ind. Mus. collection.

Male.—Abdomen 55 mm. Hind-wing 44 mm. (Fig. 6a.)

Head.—Eyes pale olivaceous brown ; labium ochreous ; labrum bright citron yellow bordered finely with black and with a median prolongation of the black at base ; anteclypeus dark brown, postclypeus bright yellow with a pale brown centre ; frons golden brown, darker above ; occiput raised, yellow fringed with long black hairs.

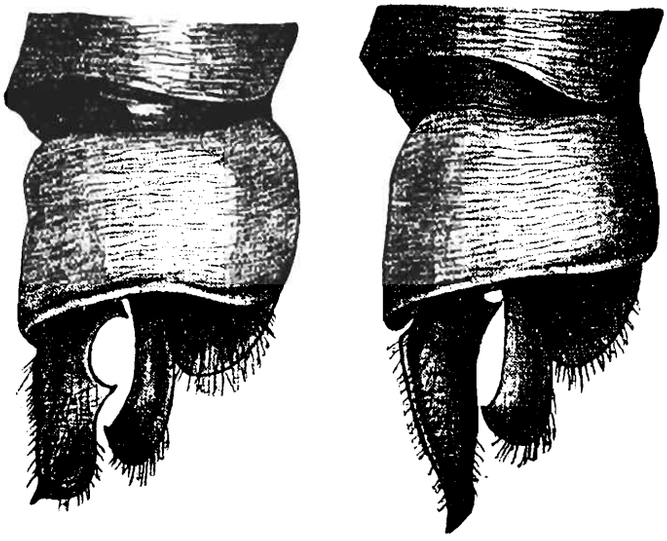
Prothorax black, a yellow spot on each side of posterior lobe.

Thorax blackish brown on dorsum, dark reddish brown laterally, marked with a greenish yellow antehumeral stripe which is broader above than below and curved inwards to nearly meet its fellow below the ante-alar sinus. Two broad oblique yellow stripes on each side, the intervening space bearing an upper and a lower small yellow spot.

Legs entirely black.

Wings hyaline ; pterostigma dark brown ; all discoidal cells traversed once only ; subtriangles entire ; 5 to 7 cells in the anal loop ; nodal index, $\frac{13-17}{14-12} \Big| \frac{17-13}{12-14}$; 2 cubital nervures in all wings ; supratriangles traversed once in all wings ; anal triangle well-formed, of 4 cells.

Abdomen black on dorsum, reddish brown on the sides, marked with yellow as follows :— segment 1 blackish brown, segment 2 with a subdorsal lunule on either side bordering the



A *B*

TEXT-FIG. 6.—A. Anal appendages of *Allogaster annandalei* (Fraser) ♂. B. Anal appendages of *Anotogaster gregoryi* Fraser ♂ From types in Indian Museum collection.

apical side of jugal suture, a small rounded spot on the outer side of these and a pair of subdorsal apical lunules, segments 3 to 6 with similar subdorsal and apical lunules but without the lateral spots, segment 7 with the subdorsal lunules and a tiny baso-lateral spot, segment 8 similar but the subdorsal spots reniform in shape, segment 9 with a subdorsal rounded pair of spots only, whilst segment 10 has an oblique linear subdorsal spot on each side.

Anal appendages black. Superiors with a robust ventral spine at the extreme base and a second one rather distad of the middle of appendage. The apices rather blunt but with a minute point in prolongation of a strong keel running the length of dorsum of appendage.

Inferior appendage subquadrate, its sides converging gradually on apex which is slightly notched and bears a small spine on either side.

Distribution.—Yunnan. A second examination of the type shows by the ground colour, the great height of the frons and the angulated tornus of hind-wing with well-developed anal triangle that this species belongs to the genus *Allogaster*. The distortion and incurling of the bases of the hind-wings deceived one at the primary examination into thinking that the species was an *Anotogaster*. The species is closely related to *latifrons*, from which it differs by its facial and other markings. The type is a spirit specimen originally preserved by its collector in raw native spirit and thus is in a poor and macerated condition.

Genus **ANOTOGASTER** (Selys 1854).

Anotogaster, Selys, *Bull. Acad. Belg.* (2), XXI, p. 101 (1854) ; *Id.*, *Mon. Gomph.*, p. 322 (1857) ; Kirby, *Cat. Odon.*, p. 79 (1890) ; Williamson, *Proc. U. S. Nat. Mus.* XXXIII, pp. 276, 277 (1907) ; Fraser, *Journ. Bombay Nat. Hist. Soc.* XXIX, p. 38 (1923).

Head very massive; eyes meeting at a point only, slightly tumid behind, rather more so in the female than male; occiput small, slightly elevated along its hinder border; labium with medial and lateral lobes equal, the latter cordate, all narrowly and shallowly notched; labrum slightly hollowed out along its anterior border; face deeper than broad, not concealing or overlapping the eyes in any way; frons broad, high but not higher than occiput, broadly and shallowly excavate above, coated evenly with short fine hairs; the face in the latter respect comparatively naked and not fringed laterally as in *Allogaster*; vesicle very small, not obscuring ocelli; antennae seven-jointed, the basal joint short, rounded, the second long and very robust, the third as long as second but slim, the fourth to sixth less than half the length of third, the terminal or seventh very short and filamentous.

Prothorax short and massive, posterior lobe rounded, tumid.

Thorax relatively massive, usually coated with fine downy hairs especially on dorsum, but less so than in *Cordulegatser*.

Legs robust, hind femora extending to about the middle of second abdominal segment, armed with a row of widely-spaced, very short, obtuse spines on the outer side, and a double row of more closely-set, sharper spines on the inner, two longer spines at the extreme distal end; tibiae with a row of moderately closely-set, moderately long, evenly-sized, sharp spines on the inner side, and a row of evenly-sized blunt teeth on the outer; anterior tibiae with a short distal keel, which is absent in the female. (In the female the armature is somewhat different, the hind femora with a single row of rather closely-set, robust short spines, the tibiae with inner and outer rows of long evenly-sized spines, instead of the outer row of teeth seen in the male). Claw-hooks robust, situated about the middle of claws.

Wings hyaline, females usually having a patch of bright amber-tint at bases of all wings. Hind-wings broad; reticulation very close; base of hind-wing straight, tornus slightly rounded, termen meeting base at slightly more than a right angle (base of hind-wing in the female only slightly more rounded than in the male); membrane broad and long; pterostigma long and narrow, unbraced; discoidal cells of similar shape in fore- and hind-wings, costal and distal sides nearly equal, base only half, or slightly more than half as long, traversed usually once in all wings, but irregular in the larger species where the triangles may be 2- or 4-celled, especially in the fore-wings; subtriangle scarcely differentiated from the cubital space, entire or traversed once; ante- and post-nodal nervures numerous; no basal subcostal nervure; bridge traversed many times; discoidal field beginning with a row of 3 to 4 cells and continued as 2 rows for a variable distance; *IA* pectinate in all wings; *Cuii* in fore-wing nearly straight, so that discoidal field scarcely dilated at termen; a small but well-defined anal loop in hind-wing; sectors of arc arising at centre of arc, diverging gradually thereafter; arc situated between the 2nd and 3rd antenodal nervures; 1 or 2 cubital nervures in all wings in addition to that forming the base of subtriangle; anal triangle not differentiated from rest of anal field; supratriangles traversed once in all wings, more rarely twice in one or other of fore-wings.

Key to species of *Anotogaster*.

1 { Very large species with abdomen 64 to 75 mm. long, and hind-wing 50 to 55 mm. long. (Females still larger) 2
Smaller species with abdomen 52 to 58 mm. long and hind-wing 42 to 46 mm. long. (Females proportionately larger) 4

2	Abdomen very broadly ringed with yellow, that of the female almost entirely yellow ..	*A. klossi.*	
	Abdomen black very narrowly ringed with yellow ..		3
3	Frons entirely black above ..	*A. gigantica.*	
	Frons with a broad transversely oval greenish yellow spot above ..	*A. sieboldii.*	
4	Neuration of wings entirely black ..		5
	The costa, first antenodal nervure, arc, costal and distal sides of discoidal cell and basal portions of *IA* and *MA* bright yellow ..		6
5	Face dark reddish brown	*A. nipalensis.*	
	Face black brightly marked with citron yellow	*A. gregoryi.*	
6	Abdominal segments 8 to 10 black marked with yellow ; frons bordered with black below and for the basal half above	*A. basalis basalis.*	
	Abdominal segments 8 to 10 entirely yellow or with but fine black markings ; frons unmarked with black in front and only narrowly above at base	*A. basalis palampurensis.*	

Anotogaster basalis basalis Selys (1854).

Anotogaster basalis, Selys, *Bull. Acad. Belg.* (2) XXI, p. 102 (1854) ; *Id., ibid.* (2) XXXVI, p. 507 (1873) ; *Id., Mon. Gomph.* p. 593 (or 323) (1858) ; Williamson, *Proc. U. S. Nat. Mus.* XXXI, pp. 276, 277 (1907) ; Kirby, *Cat. Odon.* p. 79 (1890) ; Fraser, *Journ. Bombay Nat. Hist. Soc.* XXIX, p. 39 (1923).

Coll. Selys, 4♂, 2♀, all from N. India, Naini Tal and Kulu, Punjab ; coll. MacLach., several of both sexes from same locality ; coll. Br. Mus. 4♀, N. and N. W. India, from Saunders collection, one of which is the Selysian type ; coll. Paris Mus. 1♂, without locality ; coll. Petrograd Mus. 1♂, from Himalayas ; coll. Fraser, 1 pair from Bhim Tal, Kumaon.

Male.—Abdomen 53 to 56 mm. Hindwing 42 to 44 mm.

Head.—Labium pale brownish yellow ; labrum bright citron yellow narrowly edged with reddish yellow and occasionally marked with a small medio-basal furrow of black and a vestige of a basal black line most evident at the sides ; anteclypeus black ; postclypeus bright citron yellow with two small oval punctate brownish marks near the centre ; frons in front bright citron yellow narrowly bordered below with black, its upper surface citron yellow, the basal half black, this colour extending to the sides ; vertex and occiput black, the latter fringed with coarse yellow hairs ; eyes bottle-green during life, glossy black behind ; basal joint of antennae citron yellow.

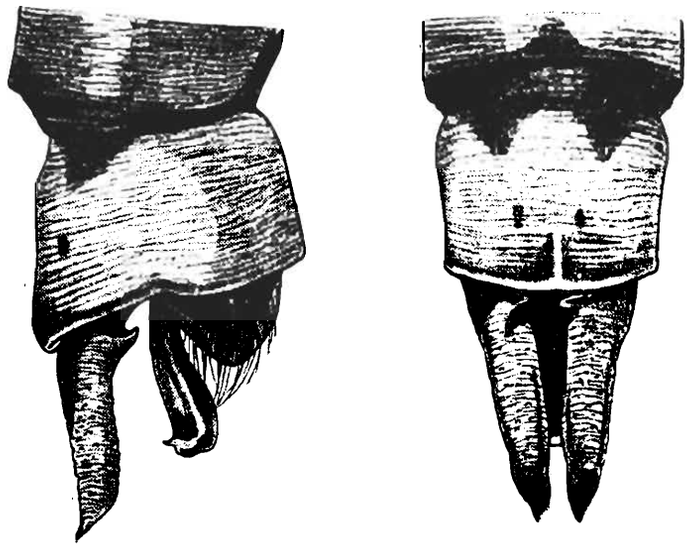
Prothorax black with a basal ring and the border of posterior lobe narrowly yellow.

Thorax black marked with greenish yellow as follows :—two pyriform antehumeral stripes, very broad and in close apposition above, tapered to a fine point and widely divaricate below ; laterally two broad oblique stripes, the anterior posthumeral and slightly overlapping the spiracle, the hinder covering the greater part of metepimeron.

Legs black, armature as for genus.

Wings hyaline, costa bright citron yellow to beyond pterostigma, as also the first antenodal nervure, the arc, the costal and distal sides of the discoidal cell and basal portions of *IA* and *MA* ; pterostigma black, moderately long, covering 3½ cells ; membrane long, broad, white ; 2 cubital nervures in fore-wings, 1 or 2 in the hind in addition to the base of sub-

triangle ; all discoidal cells traversed once by a nervure running from costal to distal sides, the nervure strongly curved in the cell of forewing ; supratriangles entire or more rarely traversed once in forewings, still more rarely in the hind ; anal loop 3- to 6-celled ; anal triangle not distinctly differentiated from rest of anal field, 4-celled ; nodal index,— $\frac{12-18}{13-12}\left|\frac{18-12}{13-12}\right.$, $\frac{8-15}{9-10}\left|\frac{16-10}{11-9}\right.$; discoidal field beginning with a row of 3 cells and continued as 2 rows to level of inner end of bridge.



TEXT-FIG. 7.—Anal appendages of *Anotogaster basalis basalis* Selys, ♂.

Abdomen black broadly ringed with citron yellow as follows :—segment 1 narrowly yellow apicad ; segment 2 with a broad dorsal annule interrupted laterally, occupying about the basal half of segment subdorsally, and about one-third on the middorsum, segments 3 to 7 with broad annules occupying about one-third the length of segments, situated about the middle of segment on dorsum but passing obliquely basad on the sides ; segment 8 with a similar annule situated nearer base of segment and occupying about half its length but greatly narrowed as traced on to middorsum of segment ; segment 9 with a similar annule occupying the basal half of segment laterally but only the basal fourth on dorsum, whilst segment 10 has a similar but still broader annule occupying the basal three-fourths on the sides and basal half on dorsum.

Anal appendages dark reddish brown to black. Superiors slightly longer than segment 10, constricted at extreme base, dilated thereafter with straight outer border and convex inner, somewhat squared at apex but ending in an acutely pointed apical spine in continuation with the outer border ; apices turned up rather abruptly ; two robust ventral teeth, one situated at the extreme base, the other towards the inner side at about the middle of appendages. Inferior appendage broad at base, tapering slightly to apex which is squared and slightly notched, and, as seen in profile, tumid and ending in a robust short spine on each side.

Genitalia.—Lamina broadly arched, projecting slightly as seen in profile, reddish brown or yellow ; anterior hamules foliate, the inner borders curling strongly inward similarly to *C. annulatus* ; posterior hamules very long stilet-shaped organs, tapering rapidly and converging until they almost meet over dorsum of penis ; lobe yellow, rather short, scrotal-shaped, slightly emarginate and very shallowly notched.

Oreillets on segment 2 rudimentary but more pronounced than in other species of the genus ; armed with 3 to 4 tiny black teeth.

Female.—Abdomen 59 mm. Hind-wing 51 mm.

Very similar to the male in colouring and markings ; abdomen more robust, markedly laterally compressed ; segment 9 aborted, oblique and produced ventrad into a long ovipositor which extends well beyond end of abdomen (8 to 9 mm. in length).

Adult females have the face markings more restricted than in the male (a female in the Br. Mus. collection has the whole of face black save for a yellow stripe across the postclypeus and the greater part of labrum). Usually the medio-basal black furrow of labrum and the fine basal black line to same better defined than in the male, the anteclypeus jet black, the postclypeus entirely and narrowly framed in black as also the front surface of frons, where the yellow may be reduced to a small oval spot or entirely absent, whilst above the yellow is reduced to a transversely oval spot.

Thoracic markings similar to the male but often a small lower spot between the two lateral stripes. Abdominal markings broader than in the male, covering slightly more than one-third the length of segments, more than the basal half of the 8th ; the 9th and 10th yellow marked or clouded with dark brown, a spot on the dorsum and one on the sides of 9 and the apical border narrowly of 10 with two subdorsal fine lines confluent with same.

Wings hyaline or enfumed, with clear cell-middles, bases of all tinted with golden or greenish yellow of varying intensity according to age, bright and intense golden yellow at the base in subtenerals, pale and of a greenish yellow in old adults as far out as the distal end of discoidal cells or 3 cells beyond this level along the costal margin, and extending back for a short distance in the anal area ; pterostigma blackish or dark reddish brown, covering about $2\frac{1}{2}$ cells ; membrane brown ; all discoidal cells traversed once ; supratriangles traversed once or entire ; 2 to 5 cubital nervures in the fore-wings, 2 to 3 in the hind in addition to the base of subtriangle ; nodal index,—$\frac{14-20}{10-13}\Big|\frac{19-14}{14-9}$, $\frac{12-17}{10-13}\Big|\frac{18-12}{14-9}$; anal loop 4/5-, 5/7-, or 6/8-celled.

Vulvar scale glossy black at apex, dark reddish brown at base; anal appendages short blackish-brown pointed.

Distribution.—North and N. W. India, Bengal and north Punjab, a pair in the author's collection is from Bhim Tal, Kumaon Hills, 4,600 ft. collected in September. Some variation in the markings of the abdomen are seen, remindful of *C. insignis* and its subspecies; one of these differs in so many points that I have thought it best to treat it as a subspecies under the name of *palampurensis* and distinguishable from the type by the greater extent of yellow markings of abdomen, etc., the three terminal segments being practically unmarked with black.

Anotogaster basalis palampurensis, subsp. nov.

Coll. Fraser, 1♂, the type, from Palampur, 4,000 ft., Sikkim ; coll. Selys, 1♀, labelled,—" *A. nipalensis*, from coll. McLachlan."

Male.—Abdomen 52-56 mm. Hind-wing 43 mm.

Differs from *A. basalis basalis* as follows :—

Head.—Labrum entirely yellow, the mediobasal blackish furrow occasionally present ; frons citron yellow unmarked in front and only at base above where the basal line is reddish brown, not black.

Prothorax with only two short linear spots on posterior lobe.

Thorax with much broader antehumeral stripes and the lateral oblique stripes somewhat broader, a small spot on the lower part of humeral suture and another on the sides below between the lateral bands.

Abdomen with the yellow more extensive,—segment 1 with a small subdorsal triangular spot and a short subdorsal apical linear spot on each side ; segment 2 with the yellow annule covering quite two-thirds of the length of segment on dorsum, and not interrupted on the sides, the apico-ventral angle also yellow and confluent along the ventral border on each side with the annule ; segments 5 to 7 with the annules broadening out on the sides apicad and basad, whilst on 7 the annule also extends apicad along the dorsum so that most of this segment is yellow ; segments 8, 9 and 10 entirely yellow save for a narrow apical black ring on 8, a small apico-dorsal triangle of black on 9 and the extreme border of 10 apicad.

Wings as for *A. basalis basalis* but all supratriangles entire, only 2 to 3 cubital nervures to all wings, anal triangle with 5 cells and the anal loop usually open or of 5 cells ; nodal index, $\frac{11-19}{12-14}\Big|\frac{18-11}{14-12}$, $\frac{11-17}{12-12}\Big|\frac{17-12}{11-12}$; the pterostigma definitely black bordered with bright citron yellow along costa.

Anal appendages and genitalia not differing from genotype.

Distribution.—Nepal and Sikkim. A female, in the Selysian collection, perhaps belongs to this, four-fifths of segment 2 and the whole of segments 8 to 10 being citron yellow.

Anotogaster nipalensis Selys (1850).

Anotogaster nipalensis, Selys, *Bull. Acad. Belg.* (2) XXI, p. 102 (1850) ; *Id.*, *Mon. Gomph.* p. 325 or 585 (1858) ; Williamson, *Proc. U. S. Nat. Mus.* XXXI, pp. 276, 277 (1907) ; Kirby, *Cat. Odon* p. 79 (1890) ; Fraser, *Journ. Bombay Nat. Hist. Soc.* XXIX, pp. 39-40, figs. 3 and 4 (1923).

Coll. Selys, 1♂ Nepal, 1♂ Sibsagar, Assam ; coll. B. M. 1♂, the type, from Nepal, labelled by Selys " nepalensis ", not " nipalensis " ; coll. Fraser, 2♂ and 3♀ Darjeeling district and Sikkim ; coll. Darjeeling Mus., several of both sexes, collected at Mungpoo, Darjeeling district, 3,000 to 4,000 ft.

Male.—Abdomen 54 mm. Hind-wing 45 mm.

Head.—Labium ochreous ; labrum black bordered with dark ochreous, the black enclosing two transversely oval citron yellow spots ; face and frons dark brownish yellow, the superior surface of latter black or blackish brown ; occiput black, densely fringed with coarse black hairs.

Prothorax dark brown, unmarked.

Thorax black changing rather abruptly to warm reddish brown beneath ; marked with bright citron yellow as follows:—two pyriform antehumeral spots broadening above, tapering below and diverging outwards and downwards ; two oblique moderately narrow lateral stripes, one bordering the hinder part of humeral suture, the other covering the central portion of metepimeron, somewhat broadened above ; lastly some spots on tergum at bases of wings.

Legs black, armature as for genus.

Wings hyaline, reticulation very close, black ; pterostigma black, rather short, covering 2½ cells ; membrane greyish brown ; discoidal cells 2-celled in all wings, divided by a nervure

running obliquely from costa to distal sides. (Rarely entire in the hind-wings only). Supratriangles traversed once in all wings ; subtriangles entire ; nodal index— $\frac{12-17}{13-11}\Big|\frac{18-11}{13-12}$; $\frac{12-18}{13-12}\Big|\frac{17-11}{13-12}$; $\frac{12-18}{13-12}\Big|\frac{18-12}{12-12}$; 2 cubital nervures in forewings, 1 or 2 in the hind ; discoidal field with 2 rows of cells to about the level of bridge ; anal loop 5-celled.

Abdomen black marked with bright citron-yellow rings bordering the jugal sutures behind on segments 2 to 8, all narrowly interrupted by the dorsal carina except on segment 2 where the ring is entire. Laterally the rings prolonged obliquely basad and becoming confluent with broad cordate spots beneath. Segment 9 with an occasional basal subdorsal spot, segment 10 unmarked.

Anal appendages black ; superiors subcylindrical, rather longer than segment 10, constricted at extreme base, tapering to apex, compressed somewhat laterally, armed with a robust ventral spine immediately after the basal constriction and a second, more robust spine, situated slightly basad of middle of appendage and directed obliquely inwards. Inner border of appendage sinuous, outer nearly straight and produced into a fine apical spine which turns rather abruptly upwards. Inferior appendage subquadrate, about three-fourths the length of superiors, hollowed out above, shallowly and narrowly notched at apex and with a small upwardly directed spine situated on either side of notch.

Genitalia almost identical with that of *basalis*, but with the lobe more deeply notched above and more emarginate. The lamina reddish-yellow, the lobe yellow.

Female.—Abdomen 58 to 60 mm. Hind-wing 48 to 50 mm.

Very similar in colour and markings to the male, differing as follows:—The whole build of insect much more robust ; abdomen markedly compressed, tumid from segments 1 to 3, tapering on segment 4, of even width thereafter ; segment 9 aborted as for rest of genus, oblique and prolonged below into an enormous ovipositor, 10 mm. in length, which projects well beyond end of abdomen and bears a dark reddish brown spot at its base.

Wings broader than in male, slightly enfumed throughout especially towards the apices, and bearing on all wings a bright amber-tinted basal fascia which extends to outer limits of discoidal cell and to hinder border of fore-wings and halfway across anal loop in the hind , pterostigma blackish brown ; 2 cubital nervures in all wings or only 1 in the hind in addition to that forming base of subtriangle ; triangles of fore-wings 2 or 3-celled, usually the latter, 2-celled in the hind ; supratriangles traversed once or more rarely entire in the hind-wings ; membrane very narrow, coloured as in the male ; nodal index— $\frac{16-20}{13-14}\Big|\frac{21-13}{14-13}$; $\frac{17-21}{18-15}\Big|\frac{20-18}{15-16}$; $\frac{16-22}{16-14}\Big|\frac{20-15}{14-15}$.

Distribution.—Nepal, Sikkim and northern Bengal (Darjeeling district). I found exuviae of this insect clinging to rushes in a small stream meandering through a swamp at Mungpoo, above the Teesta valley, 3000 ft., a situation very similar to ones favoured by *Cordulegaster annulatus*. Restricted to altitudes of 3000 to 6000 ft.

[**Anotogaster gregoryi** Fraser (1923).]

Anotogaster gregoryi, Fraser, *Journ. Asiat. Soc. Bengal* (n. s.), XIX, No. 9, pp. 453, 454, figs. 2 and 2*a* (1923).

Coll. Indian Mus. 1♂, 1♀, Chitsung, Valley of Yangtse, and Kakatang, both in Yunnan. (The ♂ the type, both specimens in very poor condition.)

Male.—Abdomen 58 mm. Hindwing 46 mm. (Fig. 6*b*.)

Head.—Labium pale yellowish brown ; labrum black enclosing two large transversely oval yellow spots ; anteclypeus black ; postclypeus yellow bordered with black below from which project two small antemedial prolongations ; frons black in front and above, a moderately broad stripe of citron yellow traversing its crest ; vertex and occiput black fringed with coarse black hairs ; eyes brown, probably green during life.

Prothorax and thorax black marked with citron yellow as follows:—a pair of antehumeral stripes broad above where they are separated by only the middorsal suture, tapering and diverging widely below ; laterally a broad posthumeral stripe, an upper and lower medial spot, and a very broad oblique stripe covering the greater part of the metepimeron.

Legs black.

Wings hyaline, palely enfumed and uniformly tinted with yellow but rather more deeply along the costal border, apices palely enfumed ; pterostigma dark brown, covering 3 to $3\frac{1}{2}$ cells, 3 to 4 mm. in length ; membrane dirty white ; only a single cubital nervure to all wings ; anal loop 5-celled ; anal triangle ill-defined, 7-celled ; discoidal cell 2-celled in fore-wings, entire in the hind ; supratriangles entire in all wings ; nodal index,— $\frac{10-16}{10-11}\Big|\frac{17-17}{12-10}$.

Abdomen black marked with citron yellow as follows,—segment 1 with a broad triangular dorsal spot, its base at apical border of segment ; segment 2 with a narrow annule running from the base of segment at its ventral border obliquely back to traverse dorsum just behind the jugal suture ; segments 3 to 7 similar but the rings more narrow ; segment 8 with a large lateral subbasal spot on each side ; segment 9 with a smaller basal spot on each side, whilst segment 10 has an oblique oval spot on each side. Segments 2 to 6 with small apical lunules.

Anal appendages black ; superiors broad at base as seen in profile and with a robust baso-ventral spine, tapering thereafter as far as apex which is inclined very slightly up. At the base and in juxtaposition to the basal spine, a second one directed inward, so that it is only visible when the appendage is viewed obliquely from above. Inferior appendage nearly one-third shorter, blunt and rounded at apex and with two vestigial spines on the upper surface.

Genitalia.—Closely resembles that of *C. annulatus*, the lobe with lip rather deeply notched and borders emarginate. Oreillets absent.

Female.—Abdomen 58 mm. Ovipositor 9 mm. Hind-wing 50 mm.

Closely similar to the male in markings, differing only in sexual characters. Wings uncoloured at base, thus differing from most other species of the genus ; costa black outwardly, yellow inwardly ; nodal index,— $\frac{13-19}{14-14}\Big|\frac{19-15}{13-14}$; discoidal cell of fore-wings with 2 to 3 cells, only 2 in the hind ; membrane white.

Abdomen similar to the male but the apical lunules only present on segments 2 and 3 ; segment 9 with a narrow basal spot on each side, whilst segment 10 is unmarked.

Anal appendages short, narrow, conical, black ; vulvar scale 9 mm. in length, glossy black.

Distribution.—Yunnan. The single pair were preserved in a weak native spirit and thus underwent considerable maceration and are in very poor condition. Differs from *A. nipalensis* by the brightly contrasted markings of the face and by the absence of any basal marking to the wings in the female ; from *basalis* by the much narrower annules on abdomen

and also by the absence of bright yellow nervures seen in the wings of *basalis*. Lastly its comparative small size will determine it from the larger species *sieboldii* and *gigantica*.

Anotogaster sieboldii (Selys 1854).

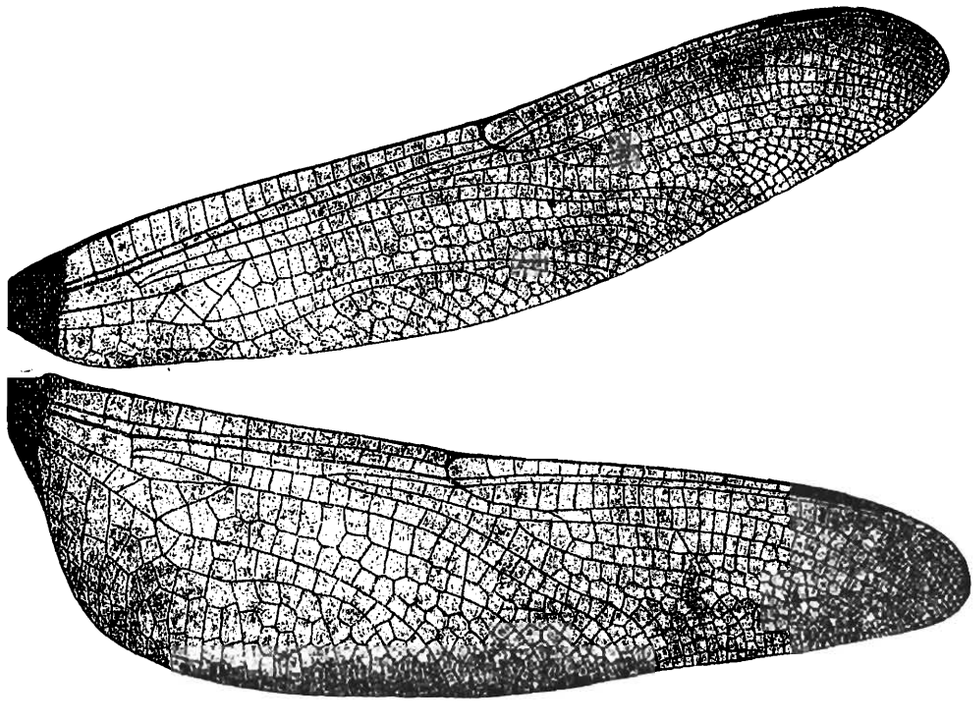
Cordulegaster sieboldii, Selys, *Bull. Acad. Belg.* (2), XXI, p. 107 (1854); *Id.*, *ibid.* (2), XXVII, p. 202 (1869); *Id.*, *Mon. Gomph.*, p. 805 or 545 (1858).

Anotogaster sieboldii, Selys, *Ann. Soc. Ent. Belg.*, XXVII, pp. 115, 116(1883); Kirby, *Cat.*, *Odon.*, p. 79, (1890).

Anotogaster kuchenbeiseri, Foerster, *Ann. Soc. Ent. Belg.*, XLIII, pp. 68 and 69. (1899).

Coll. Selys, 16♂ and 5♀, all from Central China, Pekin, N. China, and Yokohama, Japan. (The small types named by Foerster are from the mainland, whilst the larger specimens come mostly from Japan),—coll. Br. Mus. 3♂ and 4♀ all from Japan,—coll. Paris Mus. 1♂ from Tokio, Japan, Mt. Nikko,—coll. Foerster, 2 pairs from Mt. Ta-Chiaose, east of Pekin, one of which is the type of *kuchenbeiseri*,—coll. Fraser, one pair from Japan.

Male.—Abdomen 67 to 73 mm. Hind-wing 52 to 55 mm. Yellow.



TEXT-FIG. 8.—Wings of *Anotogaster sieboldii* Selys, ♂. (W. C. Davies photo.)

Head.—Labium pale brown; labrum glossy black with two large quadrangular basal spots slightly separated by a medio-basal black furrow; anteclypeus black; postclypeus bright citron yellow, as also bases of mandibles; frons black anteriorly and above, the crest above with an elongate transversely oval spot of greenish yellow; vertex and occiput black; eyes dark brown, probably bottle-green during life.

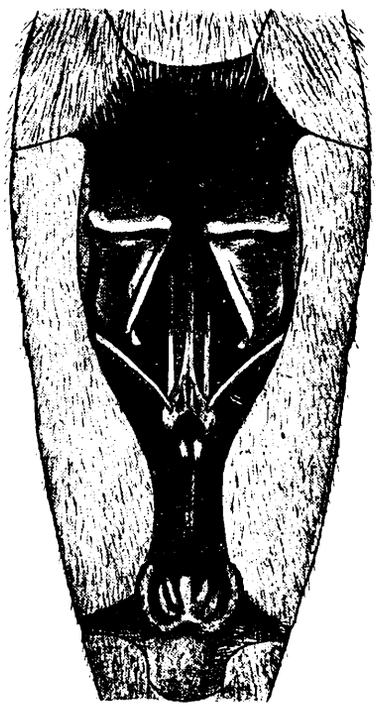
Prothorax black, unmarked. Thorax black marked with a pair of antehumeral pyriform-shaped spots on dorsum, thick above, tapering below, and two oblique stripes on each side, the anterior posthumeral and moderately broad, the posterior broader and covering the middle portion of the metepimeron. Legs black.

Wings hyaline, palely tinted with yellow, neuration black; pterostigma moderately long, covering 4 to 5 cells, narrow, black; discoidal cells of similar shape in the two wings.

2-celled ; supratriangles entire or traversed once ; 3 to 5 cubital nervures in fore-wings, 2 to 3 in the hind ; nodal index— $\frac{17-24}{18-15}\Big|\frac{21-15}{15-16}$; $\frac{14-17}{16-14}\Big|\frac{19-16}{13-17}$; $\frac{16-21}{16-15}\Big|\frac{21-15}{15-15}$; anal triangle 4 to 6-celled ; 4 to 5 cells in anal loop ; membrane white.

Abdomen black marked with narrow yellow rings as follows :—segment 1 entirely black ; segment 2 with a very broad ring lying basad to the jugal suture on the sides and touching the base, but apicad to the suture on the dorsum and subdorsum ; segments 3 to 8 with much narrower rings, very oblique on 3 and crossing the dorsum at middle of segment, lying considerably nearer the base on all other segments and interrupted on all at the middorsal carina ; segments 9 and 10 unmarked.

Anal appendages black. Superiors thick at base where they are furnished with a very robust ventral tooth, flattened thereafter and lying in an oblique plane so that a second and more robust ventral spine is not visible from the side but is seen sloping inwards from the middle of appendage when viewed from above ; apices acute, curling up almost imperceptibly, inferior appendage much shorter, flat, tapered, very slightly notched, blunt at apex and furnished at each upper corner with a minute spine.



TEXT-FIG. 9.—Genitalia of *Anotogaster sieboldii* Selys, ♂.

Genitalia.—Lamina arched ; hamules broad and foliate, very similar to those of *Cordulegaster annulatus ;* posterior hamule elongate, thin and sinuous and pointed at apex ; lobe elongate, narrow, its lips emarginate, its opening with two well-marked furrows divided by a prominent ridge.

Female.—Abdomen 79 mm. (with ovipositor). Hind-wing 60-62 mm.

Marked exactly like the male. A much more robust insect with massive head and thorax and markedly compressed thick abdomen. Segment 9 has a middorsal obscure yellow stripe, segment 10 is thickly clothed with coarse reddish hair, especially below. Vulvar scale glossy black, obscurely yellowish at base. Anal appendages black, short, pointed.

Wings very broad and long, reticulation very close, hyaline, the bases of all tinted with greenish yellow to a varying depth as far out as the distal end of discoidal cells and along

costa to a short distance beyond the node; discoidal cells similar in shape to the male, 2 to 4 celled in the fore-wings, 2 to 3 celled in the hind; supratriangles traversed by 1 or 2 nervures; 3 to 4 cubital nervures in all wings; 6 to 7 cells in the loop; pterostigma similar to that of the male; nodal index– $\frac{18-21}{17-15}\Big|\frac{23-17}{17-17}$; $\frac{14-19}{16-15}\Big|\frac{21-16}{15-16}$; $\frac{20-23}{18-18}\Big|\frac{23-21}{17-18}$

Distribution.—Japan, North China (Pekin). I have examined a number of Foerster's *kuchenbeiseri* and feel satisfied that they are merely small continental forms of *sieboldii*. The smallest one measures, abdomen 60 mm., hind-wing 49 mm. One specimen shows apical pairs of dorsal lunules on segments 2 and 3, whilst another has a pair only on segment 2. The first specimen has also the rings on segments 3 to 7 uninterrupted and the dorsum of segment 10 and a spot on each of its sides yellow. One specimen has a tiny upper humeral spot, and two specimens have an equally tiny spot on the upper part of the space between the two lateral stripes. None of the Japanese examples possesses these markings.

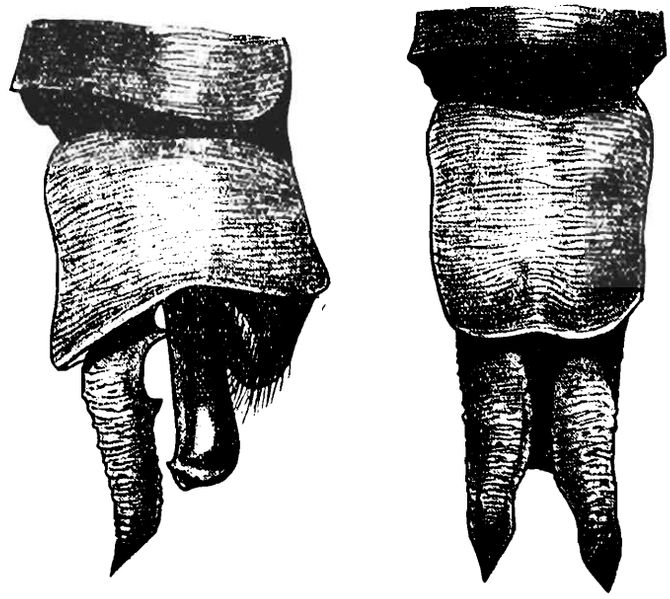
[**Anotogaster gigantica** Fraser (1924).]

Anotogaster gigantica, Fraser, *Journ. Bombay Nat. Hist. Soc.* XXX, No. 1, pp. 48-49 (1924).

Coll. Fraser, 1 ♂, 1 ♀, Kalaw, S. Shan States, 20. IX. 23; coll. Darjeeling Mus. 1 ♂, Siam Road, S. Shan States, 8. IX. 23.

Male.—Abdomen 64 mm. Hind-wing 49 mm.

Head.—Labium pale brownish yellow; labrum citron yellow broadly bordered with dark brown, the outer borders and a medio-basal furrow black, the latter nearly confluent with the dark brown foreborder; anteclypeus black; postclypeus citron yellow narrowly bordered with black; frons matt black, its upper surface broadly and shallowly excavate, black; occiput and vertex black, the former fringed with dense coarse black hairs; eyes green during life, pale brown in death.



TEXT-FIG. 10.—Anal appendages of *Anotogaster gigantica* Fras. ♂. From type in Fraser collection.

Prothorax black with a narrow transverse spot of yellow on the posterior lobe.

Thorax black marked with greenish yellow as follows:—a pair of broad short pyriform antehumeral spots on dorsum, squarely approximated above, widely convergent below;

laterally two broad oblique stripes, one posthumeral, the other covering the greater part of the metepimeron ; some large spots on the tergum and a small spot at the base of each wing ; beneath black.

Legs black, a spot at the base of the middle pair of femora behind.

Wings hyaline, the apices palely enfumed ; membrane palest brown ; pterostigma black, moderately long, covering about 3 cells ; nodal index— $\frac{11-23}{14-16}\Big|\frac{21-12}{16-15}$, $\frac{15-21}{15-15}\Big|\frac{20-14}{15-16}$; discoidal cells similar in all wings, narrow, 2-celled ; 2 to 3 cubital cells in all wings ; anal triangle 5-celled ; anal loop 4-celled ; supratriangles traversed once in all wings.

Abdomen black marked with citron yellow as follows :—segment 1 unmarked ; segment 2 with a brown oblique complete ring which meets the base of segment laterally but crosses the dorsum at its middle, a pair of small apical subdorsal lunules and a short streak at the latero-apical corner of segment ; segments 3 to 8 with similar but narrower rings which are confluent over both dorsum and ventrum and postjugal in position on the dorsum, and on segment 8 sometimes interrupted ; segment 9 with a basal stripe on each side confluent beneath segment but broadly interrupted over dorsum ; segment 10 unmarked.

Anal appendages black, as long as segment 10. Superiors thick at base, tapering to an acutely pointed apex, twisted on their long axis outwardly, bearing a robust ventro-basal spine and a second one at the junction of basal and middle thirds of appendage, somewhat smaller than the basal spine. Inferior appendage about two-thirds the length of superiors, squared at apex which is tapered and slightly notched and bears a minute spine on each side above.

Genitalia.—Lamina broad, shallowly arched, its border emarginate and fringed with long sparse hairs ; anterior hamules broad foliate, curling inwards and almost meeting ; posterior hamules long thin stilet-shaped organs ; lobe tumid, shortly truncate, its borders curled up like the protruded tongue of a dog.

Female.—Abdomen 80 mm. Hind-wing 63 mm.

Colour and markings almost entirely similar to those of male ; the labrum very broadly bordered with black and the yellow spots entirely divided by a confluence of this border with the medio-basal black furrow. (In one of the males the spots are also divided.) The post-clypeus broadly black along its lower border and confluent with two small submedial spots ; the abdominal markings similar but in the unique specimen rather obscured by decomposition.

Anal appendage very short, conical, black. Ovipositor entirely black, 12 mm. in length.

Wings hyaline, deeply tinted with rich golden yellow at bases as far as the outer limit of discoidal cells and as far back as the hinder border in the fore-wing, and level of discoidal cell in the hind ; anal loop 6-celled ; 3 to 4 cubital nervures to all wings ; nodal index— $\frac{17-21}{20-18}\Big|\frac{24-18}{18-19}$; other venational details similar to the male.

Distribution.—Northern Burma, Shan States on the Chinese frontier. The species is easily distinguished from other Indian forms by its enormous size and from *sieboldii*, which it greatly resembles and to which it is evidently closely related, by the upper surface of frons entirely black in both sexes. Its reticulation is decidedly more open than this insect and its build is not quite as robust.

Type and paratype in Fraser collection.

[**Anotogaster klossi** Fraser (1919).]

Anotogaster klossi, Fraser, *Journ. Nat. Hist. Soc. Siam*, III, No. 4, pp. 456, 457 (1919).

Coll. Br. Mus. 1 ♀, the type, Daban, Pharang Province, 650 ft., Mar. 1918.

Female.—Abdomen 80 mm. Hind-wing 67 mm. (Male unknown.)

Head.—Eyes green ; labium pale yellow ; labrum citron yellow, its anterior border broadly black ; anteclypeus, postclypeus and bases of mandibles citron yellow ; occiput black above and along the crest, yellow in front ; vertex and occiput black, the latter fringed densely with short stiff coarse black hairs.

Prothorax blackish brown with a pyriform subdorsal spot on each side.

Thorax dark reddish brown marked with citron yellow as follows :—a pair of broad antehumeral stripes on dorsum with their inner border convex, broad above, tapering below and diverging widely, the antealar sinus, some spots on the tergum and at bases of wings ; laterally two broad oblique stripes, the anterior posthumeral, the posterior covering the greater part of the metepimeron. Legs black, coxae yellow.

Wings hyaline, the bases of all rich golden yellow for as far as 3 cells beyond the discoidal cell in fore-wing, and nearly as far as node in the hind, from which point it curves back to the tornus ; pterostigma black, narrow, covering about 4 cells ; membrane blackish ; nodal index— $\frac{19-26}{20-18}\Big|\frac{27-18}{18-20}$; discoidal cells similarly shaped in all wings, but 4-celled in the fore-wings, 3-celled in the hind ; 3 to 4 cubital nervures in all wings ; anal loop with 5 to 6 cells ; supratriangles traversed once to three times.

Abdomen tawny yellow with the apical ends changing to dark brown ; segment 1 dark reddish brown, as also segments 9 and 10, and the apical two-thirds of 8. Ovipositor 12 mm. in length, blackish brown ; anal appendages short, conical, black.

Distribution.—The unique specimen is from Siam. This magnificent insect, one of the largest dragonflies known, is distinguished at once from all others of its genus by the great extent of yellow, especially on the abdomen, which is almost entirely of that colour.

Genus **CORDULEGASTER** Leach (1815).

Cordulegaster, Leach, *Edinb. Encycl.* IX, p. 136 (1815) ; Stephens, *Ill. Brit. Ent.*, Mand. VI, p. 86 (1836) ; Selys, *Mon. Lib. Eur.* p. 95 (1840) ; *Id.*, *Libell. de la Belg. Bull. Acad. Belg.* VII, p. 7 (1840) ; *Id.*, *Rev. Odon.* p. 104 (1850) ; *Id.*, *Bull. Acad. Belg.* (2) XXI, p. 104 (1854) ; *Id.*, *Mon. Gomph.* p. 327 (1857) ; Rambur, *Ins. Nevrop.* p. 177 (1842) ; Bath, *Brit. Dragonflies*, p. 52 (1888) ; Kirby, *Cat. Odon.* p. 80 (1890) ; Lucas, *Brit. Dragonflies*, pp. 30, 41, 48 and 57 (1900) ; Williamson, *Proc. U. S. Nat. Mus.* XXXIII, pp. 276, 277 (1907) ; Morton, *Trans. Ent. Soc. London*, Parts iii and iv, p. 273 (June, 1915) ; Fraser, *Journ. Bombay Nat. Hist. Soc.* XXVIII, p. 40 (1923).

Thecaphora, Charpentier, *Lib. Eur.*, p. 14 (1840).

Thecagaster, Selys, *Bull. Acad. Belg.* (2) XXI, p. 103 (1854) ; Kirby, *Cat. Odon.* p. 79 (1890).

Head massive ; eyes meeting at a point only, tumid behind ; occiput small, slightly raised, tumid ; labium with lateral and mid-lobes subequal, the outer lobe denticulate on inner side, mid-lobe cordate, cleft at its middle ; labrum shallowly and broadly excavate along its outer border ; face deep and broad, rather deeper than broad, not overlapping the eyes ; frons raised to level of occiput, not as broad as postclypeus, shallowly and broadly excavate above, naked ; vesicle small and depressed ; antennae as for family.

Thorax massive, cubical. Legs robust, relatively short, hind femora extending nearly to apical end of segment 1 and armed with inner and outer rows of very minute, very closely-set spines ; the two hind pairs of tibiae with a row of very short, evenly-sized, very closely-set denticles on the outer side, and a row of long fine widely-spaced spines on the inner.

Wings broad and long, reticulation very close ; base of hind-wing excavate ; membrane moderately large ; pterostigma moderately long to very long and narrow, unbraced ; discoidal cells similarly shaped and of equal size in the two wings, longer than broad, distal and costal sides subequal, nearly twice the length of base, traversed once in all wings, but that of hind-wing occasionally entire ; ante- and post-nodal nervures very numerous ; bridge traversed many times ; discoidal field in fore-wing with 2 rows of cells to the level of inner end of bridge ; *IA* in both wings markedly pectinate and undulate ; anal-loop fairly well defined ; sectors of arc springing from centre of arc, separated at origin and diverging gradually distad ; 1 or 2 cubital nervures to all wings including that which forms the base of subtriangle ; anal triangle large, formed of 5 cells ; basal subcostal nervure absent in all wings ; a moderately well-defined supplement to *IRiii* in all wings, none to *MA ;* median space entire.

Abdomen long and cylindrical, dorso-ventrally tumid at base, slightly constricted at segment 3, compressed and expanded from base of segment 6 to apical end of segment 8.

Anal appendages slightly shorter than segment 10, slightly divaricate, acuminate, with one or two ventral spines beneath the superiors ; inferior appendage quadrate, shorter than superiors.

Genitalia.—Lamina hardly visible in profile, rather depressed, border straight ; anterior hamules foliate with corners rolled in, projecting markedly ; posterior hamules long thin ungulate processes, blunt, at apex arched and sinuous ; lobe scrotal-shaped, lipped and with raised margins, shallowly notched. Vulvar scale, two greatly elongate apposed laminae.

Distribution.—Europe, North Africa, Central Asia and Siberia, and North and South America. Breeding in streams at low levels in temperate zones, in montane and submontane in subtropic and tropic zones. The females leave their parent streams when feeding and may be found hawking in woods or on downs. They oviposit whilst in flight, rising and falling perpendicularly, and stabbing the water, as if drilling holes in it with their enormously lengthened ovipositor. Occasionally they are seen ovipositing similarly in shallow streams when they appear to be driving their eggs into the sandy bottom.

Genotype.—*C. annulatus* Latr.

Key to species of genus *Cordulegaster*.

1	Old World species	2.
	New World species	14.
2	Anal triangle of hind-wings normally 5-celled ; superior anal appendages of male exhibiting two ventral spines as seen in profile ; frons with or without a transverse black line immediately below its crest	3.
	Anal triangle 3-celled ; superior anal appendages of male exhibiting but one ventral spine as seen in profile ; frons with or without a transverse black line immediately below its crest	7.

3	Frons with a transverse black line immediately below its crest		4.
	Frons without a transverse black line below crest		5.
4	Yellow rings on abdomen very narrow ; superior anal appendages neither tapering nor sinuous	*C. annulatus annulatus* Latr.	
	Yellow rings on abdomen broad ; superior anal appendages tapered and sinuous ..	*C. charpentieri* Kol.	
5	Back of eyes black, narrowly bordered with white		6.
	Back of eyes white, narrowly bordered with black	*C. annulatus princeps* Mort.	
6	Black dorsal spot or stripe on segment 2 trilobate ; yellow markings on segments 8 to 10 broad and well defined	*C. annulatus algiricus* Mort.	
	Black dorsal spot or stripe on segment 2 unilobate ; yellow markings on segments 8 to 10 small, or absent on segment 10 ..	*C. annulatus immaculifrons* Selys.	
7	Yellow markings on abdomen much restricted ; occiput black with a yellow spot behind		8.
	Yellow markings on abdomen very extensive ; occiput entirely yellow		11.
8	Abdomen with yellow rings		9.
	Abdomen with yellow dorsal spots	*C. luniferus* Selys.	
9	Apical annule on segment 2 small and interrupted, and altogether absent after segment 4 ..	*C. bidentatus* Selys.	
	Apical annule on segment 2 large and complete and present on all segments as far as segment 7 or 8 and 9 ..		10.
10	Black dorsal spot on segment 2 broadly confluent with the lateral black	*C. brevistigma brevistigma* Selys.	
	Black dorsal spot on segment 2 narrowly confluent with the lateral black in the male and quite isolated in the female	*C. brevistigma folia* subsp. nov.	
11	An isolated black dorsal crown-shaped spot on segment 2 ; labrum with a medio-basal tongue of black	*C. insignis coronatus* Mort.	
	Black dorsal spot on segment 2 confluent laterally with the lateral black of segment ; no medio-basal tongue of black		12.
12	Epistome with brown markings.	*C. insignis insignis* Schneid.	
	Epistome entirely yellow		13.
13	Posterior yellow band on prothorax interrupted ..	*C. insignis amasinus* Mort.	
	Posterior yellow band on prothorax entire	*C. insignis nobilis* Selys.	
14	Occiput raised into a conical eminence at its middle ; dorsal spots of abdomen lanceolate or shaped as an arrow-head		15.
	Occiput not raised ; dorsal spots on abdomen, if present, subcordate or partially interrupted by the middorsal crest		16.

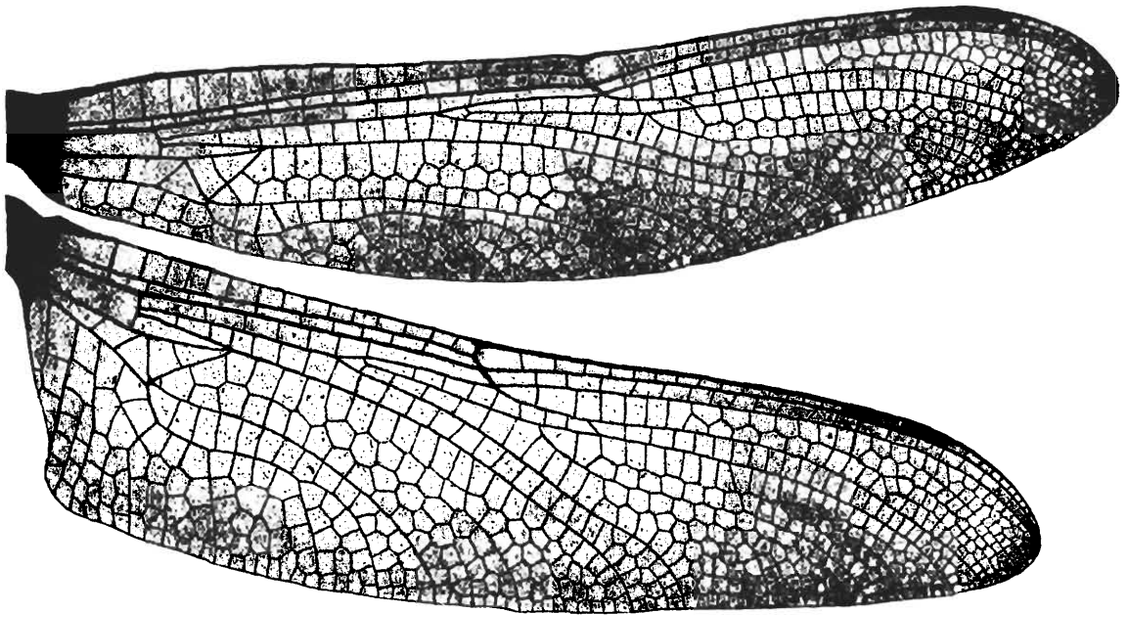
15	Species of large size, with abdomen 65 mm., and hind-wing 53-56 mm. in length ; discoidal cell 3-celled ; anal triangle 4-celled ; membrane white	*C. obliqua fasciatus* Ramb.	
	Smaller species with abdomen 48-53 mm., and hind-wing 41-44 mm. in length ; discoidal cell 2-celled ; anal triangle 3-celled ; membrane black	*C. obliqua obliqua* Say.	
16	South American species		17.
	North American species		18.
17	Dorsal spots on abdomen large and confluent, especially that on segment 7 which covers at least one-third of the segment on the dorsum and considerably more than that on the sides ; segment 8 with the greater part yellow	*C. diadema* Selys.	
	Dorsal spots on abdomen small and often interrupted on the middorsum ; dorsal spot on segment 7 not larger than that on the others ; apical half of segment 8 black	*C. godmani* McLach.	
18	Segments 9 and 10 unmarked ; a pair of middorsal lunules on segment 2 ; a pair of cordate dorsal spots on segment 7 ..	*C. maculatus* Selys.	
	Segment 10 and usually 9 marked with yellow ; middorsal lunules on segment 2, if present, always confluent and usually forming a complex figure ; dorsal spots on segment 7 small and confluent or elongate and pyriform		19
19	Segments 2 to 7 with a pair of dorsal *stripes* extending from base to apex on segments 2 to 5 and nearly to apex on 6 and 7 ; segment 8 with a pair of large subtriangular spots ; segment 10 unmarked	*C. diastatops* Selys.	
	Segments 2 to 7 with paired or single *spots* not extending from base to apex ; segment 8 with spots confluent over middorsum ; segment 10 marked		20.
20	Segment 2 with the middorsal spot X-shaped ; middorsal spots on segments 3 to 7 large and covering more than one-third of the segments ; dorsal spot on segment 8 broad and covering the basal half of segment	*C dorsalis* Hagen.	
	Segment 2 with the middorsal spot trilobate, the middle lobe extending back to base of segment ; dorsal spots on segments 3 to 7 covering more than one-third of segments ; dorsal spot on segment 8 narrow and transversely linear ..	*C. erroneus* Selys.	
	Segment 2 with the dorsal spot narrow, confluent and forming a subdorsal annule ; spots on segments 3 to 8 small and covering less than one-fourth of segments	*C. sayi* Selys.	

Cordulegaster annulatus (Latr. 1805).

Under *annulatus* are grouped a number of races, or, as I prefer to call them, subspecies, all of which are characterized by the superior appendages furnished with only a single ventral tooth as seen in profile. The subspecies are as follows :—*annulatus annulatus*, *annulatus immaculifrons*, *annulatus algiricus*, and *annulatus princeps*.

With regard to the forms from Dalmatia named *intermedius*, and regarded by Selys as a race of *annulatus*, I find, after a careful re-examination of the type and comparison with

the type of *pictus*, that they are conspecific, as Selys himself, at one time, had more than a suspicion of. I have also been able to compare these specimens with more material in the British, Paris and Vienna Museums, those in the latter being the identical specimens from Brusa, determined by Selys as *pictus*. All of these specimens undoubtedly belong to a common form which appears to be identical to Kolenati's *charpentieri*. The female in the British Museum, which is a replica of the type of *pictus*, has actually been labelled by the late Herbert Campion as *charpentieri*, whilst similar specimens in Mr. Morton's collection have been determined by the owner as belonging to the same species. Thus with the accumulated evidence, I do not think that we shall be at all wrong in considering *intermedius*, *pictus* and *charpentieri* as one and the same insect, the latter name having priority.



TEXT-FIG. 11.—Wings of *Cordulegaster annulatus* Latr. ♂. (W. C. Davies photo.)

The species has so many characteristic features that I do not think that we can treat it as a mere subspecies or race of *annulatus*, but must give it specific rank. It would appear to bridge the gap between *annulatus* and *bidentatus*.

The principal characters distinguishing this group are as follows :—

(*a*) Anal triangle of hind-wing divided into 5 cells, less rarely into 4.

(*b*) Superior anal appendages with only a single visible ventral tooth as seen in profile.

(*c*) Frons with or without a transverse black line immediately below the crest and always less pronounced than in *bidentatus*.

(*d*) Labrum margined at the base with black, less so at the sides and never along the anterior margin.

Cordulegaster annulatus annulatus Latr. (1805).

Aeschna annulata, Latreille, *Hist. Nat. Crust. Ins.* XIII, p. 6 (1805).

Cordulegaster annulatus, Stephens, *Ill. Brit. Ent.* Mand. VI, p. 86 (1836) ; Selys, *Mon. Lib. Eur.* p. 96 (1840) ; *Id.*, *Bull. Acad. Belg.* (1) VII, (sep.) Libell. de la Belg. p. 7 (1840) ; *Id. ibid.* (8) X, (sep.) Add. Libell. de la Belg. pp 7 8 (1840) : *Id.*, *Rev. Odon.* p. 105 (1850) ; *Id.*, *Bull. Acad. Belg.*

(2) XXI, p. 105 (1854); *Id.*, *Mon. Gomph.* p. 333 (1857); *Id.*, *Ann. Soc. Ent. Belg.* XXXI, p. 31 (1887); Kirby, *Cat. Odon.* p. 80 (1890); Bath, *Brit. Dragonflies*, p. 52, Pl. V (1887); Lucas, *Brit. Dragonflies*, p. 157 (1900); Morton, *Trans. Ent. Soc. London*, pp. 274-276, (parts 3 and 4) (June, 1916); Ris, *Ent. News. Phil.* XVI, p. 113 (1905); Schmidt, *Zeits. Wiss. Insbiol*, XIII, p. 33 (1918).

Libellula grandis, Scopoli, *Ent. Carn.* p. 259 (1763).

Libellula forcipata, Harris, *Exp. Eng. Ins.* t. 23, f. 3 (1782).

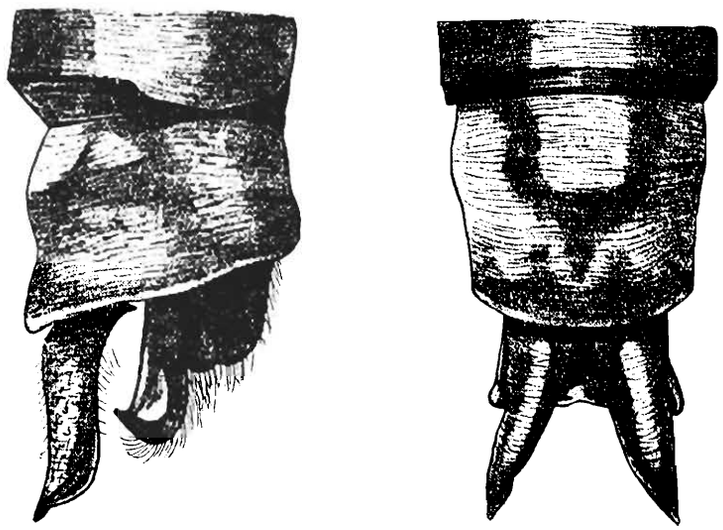
Libellula boltoni, Donovan, *Brit. Ins.* XII, t. 430 (1807).

Aeschna lunulata, Charpentier, *Hor. Ent.* p. 29 (1825); *Id.*, *Lib. Eur.* p. 118, t. 26 (1840).

Cordulegaster lunulatus, Rambur, *Ins. Nevrop.* p. 178 (1842).

Male.—Abdomen 54-58 mm. Hind-wing 43-46 mm.

Head.—Labium ochreous; labrum yellow, narrowly bordered with black at the base and less so on the sides, the black at base prolonged for a short distance at the middle but not reaching the anterior border which is immaculate; face yellow, marked with a transverse black band which covers the anteclypeus and anterior border of postclypeus; frons yellow marked in front just below the crest with a short transverse black band, whilst above the extreme base is sinuously black, this descending finely alongside the eyes; vertex black; occiput yellow, fringed with a crest of yellow hairs, tumid behind and sub-bituberculate with a blackish point at its middle; eyes greenish grey, black behind with a bordering of white near the temples. (Eyes bottle-green in the living state.)



TEXT-FIG. 12.—Anal appendages of *Cordulegaster annulatus* Latr. ♂. From a specimen from Hants, England.

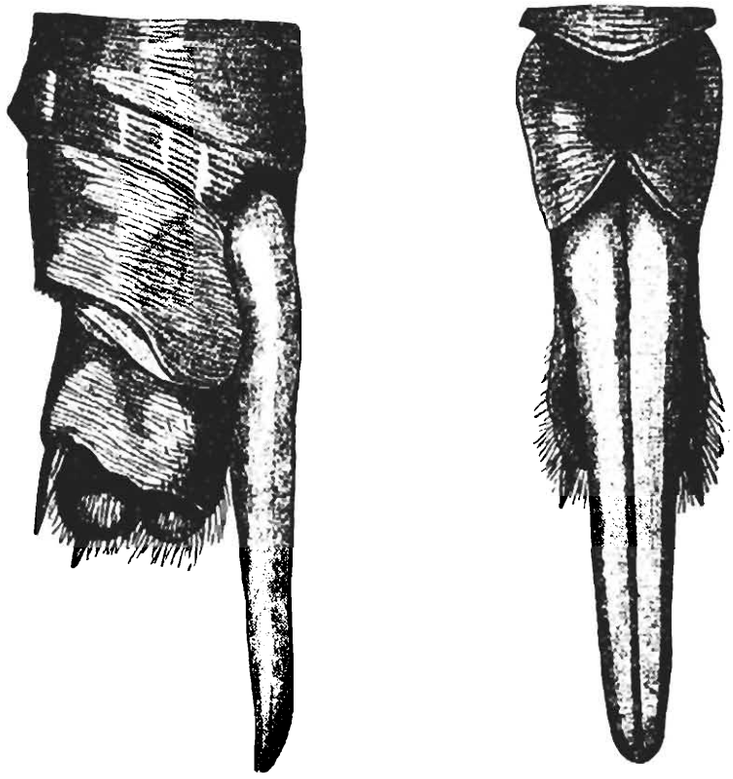
Prothorax black bordered with yellow anteriorly and posteriorly, this colour slightly interrupted at the middorsum.

Thorax coated with fine greyish hairs, black, marked with yellow as follows:—two cuneiform antehumeral stripes in front, wedge-shaped, tapering below, two oblique stripes on the sides, equal in thickness, the hinder traversing the metepimeron about its middle. The black between these stripes marked with a chain of two or three spots. Lastly a small upper humeral point, a point at the root of each wing and some spots on the tergum.

Legs black, armature as for genus.

Wings hyaline, sometimes a little enfumed, especially in old specimens. Reticulation close, black, the costa yellow anteriorly; membrane moderately long and broad, greyish white; anal border excavate, anal triangle 4-5 cells, *usually 5*; discoidal cell in all wings traversed once, subtrigone entire; supratriangles entire; 5-6 cells in the anal loop; nodal index— $\frac{15-18}{14-13}\Big|\frac{19-15}{12-15}$, $\frac{16-20}{15-15}\Big|\frac{21-16}{15-17}$, $\frac{10-16}{12-13}\Big|\frac{16-9}{13-11}$, $\frac{17-20}{16-13}\Big|\frac{20-17}{13-18}$; 3 cubital nervures in fore-wings, rarely 2, only 2 in the hind.

Abdomen tumid at base, cylindrical and slightly tapered from segment 2 to 6, broadened and a little depressed for the rest but narrowing again towards the end. Black, marked with bright citron yellow as follows :—segment 1 with a ring interrupted above before apical border (sometimes absent), segment 2 with an oblique stripe which starting laterally at the base of segment runs obliquely back bordering the jugal suture, also a pair of lunules at the apical border, slightly interrupted by the dorsal carina, segments 3 to 6 with narrow rings situated rather nearer the base than apex of segments and continued laterally towards the base of segments, whilst above and behind they are slightly notched at the middorsal carina. Similar apical paired lunules as for segment 2, segments 7 and 8 with rather broader rings situated nearer the base and distinctly interrupted on the dorsal carina, whilst that on segment 8 usually shows a slight indentation each side on its apical border, segment 9 with only a small lateral basal spot each side, segment 10 unmarked.



TEXT-FIG. 13.—Terminal abdominal segments of *Cordulegaster annulatus* Latr. ♀, showing enormous ovipositor.

Anal appendages black, superiors slightly shorter than segment 10, apposed at the base, then diverging slightly, flattened, the outer margin strongly ribbed and a little sinuous, the inner margin tapering to a point, markedly acuminate; a robust tooth situated at the basal fourth on the inner side, directed towards the base, the inner border then dilated somewhat and a little emarginate just before the apex; inferior appendage two-thirds the length

of superiors, broader than long, subquadrate, a little notched at the end, lateral border tumid, slightly curled up and pointed at the apex. Oreillets robust, yellow.

Genitalia.—Lamina slightly raised, anterior border thickened, straight; hamules foliate, the corners rolled in, projecting; posterior hamules long, ungulate, blunt-tipped, arched and sinuous, converging rapidly on penis; lobe scrotal-shaped, strongly lipped, notched.

Female.—Abdomen 57-62 mm. Hind-wing 47-50 mm.

Considerably more robust than the male, the abdomen compressed and of nearly even width throughout, the terminal segments rather stouter and the end prolonged by the usual vulvar scale. Marked exactly as in the male, but the 10th segment frequently bears a lateral yellow marking and there is a rounded yellow spot on each side of base of vulvar scale, which latter overlaps the abdomen by about 3·5 mm.

Wings longer and broader than for male, costa finely greenish yellow as far as pterostigma which is blackish brown and somewhat longer than in the male. Discoidal cells traversed once in all wings; 2 or 3 cubital nervures in fore-wings, only 2 in the hind (counting the one which completes the subtrigone); 7, or more commonly, 8 cells in anal loop; nodal index— $\frac{18-20}{16-14}\Big|\frac{19-1[illegible]}{13-14}$, $\frac{14-20}{15-16}\Big|\frac{21-14}{13-13}$

Vulvar scale black, yellow at base, 8·5 mm. in length, made up of two closely apposed laminae which arise from the ventral base of segment 9 and extend well beyond end of abdomen. Segments 9 and 10 are somewhat atrophied, the latter in some specimens (many from the New Forest, Hampshire, England) being variegated with bright yellow and bearing a small isolated subdorsal spot of the same colour at its middle.

Anal appendages shorter than segment 10, conical, pointed, black, separated by a conical protuberance.

In one specimen from Hampshire, England, the subtrigone in both fore-wings is traversed by a nervure, and there are 9 cells in the anal loops.

Distribution.—Northern and central Europe, the British Isles, Sweden, Denmark and as far eastward as Silesia. Southwards it extends into Spain and Portugal, and in France is found in the Pyrennees. Haunts forest brooks and streams, the females however frequently taking to open heather lands and pine forests, during the months of May to August.

Cordulegaster annulatus immaculifrons Selys (1858).

C. annulatus race *immaculifrons*, Selys, *Mon. Gomph.* (sep.) p. 335 (1858); Morton, *Trans. Ent. Soc. London*, parts III and IV, pp. 276-278 (1915).

Coll. Selys, 3 ♂ and 2 ♀ all without locality; 1 ♀ Chamonix, Switzerland; 1 ♀ Sicily; 1 ♂ St. Ildefonse; 1 ♂ and 2 ♀ Monspellier Alpes; 1 ♂ Italy; 3 ♂ Bordeaux; coll. Morton, 9 ♂ Basses Alpes; 12 ♂ and 5 ♀ Cagnes, Alpes Maritimes; 1 ♂ Albarracin; coll. Paris Mus. several of both sexes; specimens not uncommon in most of the European collections.

Differs from *annulatus annulatus* by the greater extent of yellow and by the frequent absence of the black stripe on crest of frons. Selys states that this race is confined to the south of Europe and gives the principal distinguishing characters as follows:

Frons entirely yellow, without the transverse black line on crest so constant a feature in *annulatus*; the basal black of labrum not descending on the sides; the white border

behind the eyes broader ; the yellow annules on the abdomen much broader and not interrupted by the black dorsal carina ; the annule on the 8th segment broadening out on the sides ; the lateral spot on segment 9 larger and an analogous spot on the sides of the 10th. In some specimens one finds a vestigial black line on the frons, whilst on others the dorsal carina on segment 8 is finely black.

The females differ especially from northern specimens by the great breadth of the median yellow annules of the abdomen, which on the 2nd and 3rd segments are confluent on each side with the apical annules so as to isolate a black dorsal spot which is rounded apicad on segment 2 and pointed on the two sides of segment 3 ; segment 8 is variable as to the dilatation of the annule but the annule is always broadly interrupted by the black dorsal carina. Very rarely is the frons entirely without the black line, but it is usually vestigial.

The black border of the labrum is incomplete as in the male. The apices of all wings in both sexes are often enfumed. In some examples the wings appear to be narrower than in the type and the costa is of a more vivid yellow.

TEXT-FIG. 13*a*.—End abdominal segments of *Cordulegaster annulatus immaculifrons* Selys, showing markings. A. Specimen from the Basses Alpes. B. Specimen from the Pyrennees. C. From Italy. D. From France. E. From Spain.

Mr. Morton (*loc. cit.*) has further studied this subspecies and notices that in specimens from the Basses Alpes, there are two more or less distinct types of pattern. In the first form the yellow markings, especially on segments 8 to 10, are restricted, whilst in the second form they are markedly developed on the same segments. In 4 males (July 1902, Morton) there is no trace of the frontal line ; in 3 of 6 examples (July 1914, Morton) there is a vestigial line. No females were taken in this locality. Examples from N. W. Spain (Morton coll.) are very close to *annulatus annulatus*. In all the frontal line is marked ; the sides of the 3 final segments are more extensively marked than in northern examples. At La Granja Mr. Morton found the males very similar to the above mentioned examples from Digne, Basses Alpes. A female taken here was more extensively marked than in the females from N. W. Spain, and the frontal line was absent.

Examples from the Alpes Maritimes, France, generally approach *immaculifrons* but show great variability in the markings of the last 3 segments, especially of the 10th, where the markings are rarely absent but more often restricted than conspicuous.

A female in the Selysian collection from Vigo is typically *annulatus* and has the markings as much restricted as in specimens from Britain.

A female from Sicily has the markings reduced, a well-marked line on the frons, the occiput yellow, the labrum yellow along its distal border and with a large basal yellow spot on each side of the vulvar scale.

A female labelled " Monspellier, Alp." has a vestigial line on the frons, a complete broad basal annule on segment 8, baso-lateral spots on 9 and a small geminate spot on each side of dorsum of segment 10.

A male from " Italie " is similar to the second form described by Morton from the Basses Alpes with conspicuous yellow markings, but the annule on segment 7 is broader than in the figure shown by Morton and the only sign of black on the labrum is a tiny medio-basal tongue. The frons is without black line.

Finally there is a male from Algeria determined by Selys as *immaculifrons*, which does not differ from Mr. Morton's second form from the Basses Alpes. Other specimens of this subspecies in the Selysian collection bear no locality, a matter for regret.

Cordulegaster annulatus algiricus Mort. (1916).

Cordulegaster annulatus immaculifrons, Selys, *in litt.*

Coll. Selys, 1 ♂ Tangier ; 1 ♂ Algeria ; coll. Morton, 3 ♂ Sebdou and Tlemcen, Algeria.

Mr. Morton thus describes this subspecies :—

Male.—Frons yellow without transverse frontal line ; anteclypeus yellow with the exception of two short black anterior lines ; postclypeus black ; labrum with its base black ; vesicle brownish ; occiput yellow with yellow fringe of hairs. The white line behind the eyes broader than in *annulatus*.

Thorax.—Humeral spot when present extremely minute ; median lateral band usually broken up into 4 spots.

Abdomen black with yellow markings. Median yellow band of segment 2 broad continued on the sides without interruption ; apical lunules large and connected by a narrow line with the lower yellow patch ; dorsal black marking trilobate on basal margin, the middle lobe narrowest and most prominent. On 3rd segment yellow dorsal marking occupies about one-third of segment and is continued basad to the ventral suture and basal edge of segment ; on segments 4, 5 and 6 dorsal yellow markings not occupying quite one-third of segment ; yellow on 7th about one-third of segment ; lunules on segments 3 to 7, those on 3 and 4 large. Segments 8, 9 and 10 much marked with yellow above and on sides.

Antenodals of fore-wings 17-19 ; of hind-wings 12-14.

Length of abdomen 55-58 mm. Length of wings 44-46 mm.

Pterostigma of fore-wings $3\frac{1}{2}$-4 mm., of hind-wings 4-$4\frac{1}{2}$ mm.

The Selysian specimens are of similar dimensions, both being large insects. Length of abdomen 56 and 59 mm. ; of hind-wings 44 and 47 mm.

The Tangier example is the larger of the two. In it the dorsal annule on segment 2 is very broad nearly extending to base of segment and with a median quadrate notch apicad

splitting it partially into two lobes ; the annules on segments 3 to 7 are very broad, covering fully one third of segment 3 and more than that on 7. Segments 8 and 9 are marked with broad figures-7, which on segment 8 have their heads broadly confluent across the dorsum. Segment 10 has an U-shaped marking on each side of dorsum (Mr. Morton's example has two superimposed comma-like figures on each side of this segment), a great variability in the markings of all these segments is apparently met with.

Venation in the Selysian specimens is as follows :—nodal index— $\frac{14-19}{15-12}\Big|\frac{17-15}{13-14}$; $\frac{17-17}{17-13}\Big|\frac{18-18}{14-18}$; supratrigones crossed $\frac{1-0}{0-0}$; $\frac{1-1}{0-0}$; 2 cubital nervures in all wings ; loop 8-celled ; anal triangle $\frac{4}{4}$; $\frac{5}{4}$; discoidal cells $\frac{1-3}{1-1}$; $\frac{3-1}{1-1}$.

The anal appendages do not differ markedly from those of typical *annulatus* but are markedly tapered as seen from above, the apical halves bent out at an angle.

Distribution.—North Africa. They represent an exaggerated type of *immaculifrons.*

[**Cordulegaster annulatus princeps** Mort. (1916).]

Cordulegaster annulatus race *princeps*, Morton, *Trans. Ent. Soc. London*, parts III and IV (June, 1916).

Morton coll. 1 ♂, 1 ♀, the former the type. (Tiflis, Caucasus.)

Male.—Abdomen 59 mm. Hind-wing 46 mm.

Head.—Labrum yellow, base bordered with black, no median black virgule ; anteclypeus yellow ; postclypeus black ; occiput yellow fringed with yellow hairs, tumid above and behind, deeply bifid behind ; behind eyes entirely white except for a black border running along upper border of eyes.

Prothorax black, hind margin with a yellow line interrupted in the middle ; anterior margin narrowly yellow.

Thorax black, marked with yellow as follows :—antehumeral yellow bands preceded by a small yellow subtriangular marking ; yellow line between lateral bands small, broken up into three short lines, all above spiracle ; no visible humeral spot.

Abdomen heavily marked with yellow ; 1st segment black with a narrow yellow lateral hind margin, the yellow increasing towards the sternum ; 2nd segment more than one-third yellow above, the black markings approximating on the sides, but leaving a large yellow space including the oreillet on the lower basal part of segment ; segments 3 to 7 with yellow dorsal markings occupying more than one-third of segment, these markings extending laterally in their basal part but in no case reaching the ventral suture ; a broad yellow band on segment 8 nearly reaching ventral suture ; segment 9 marked with yellow basad and (there seem to be) traces on both basal and apical margins of segment 10. Segments 2 to 6 with apical lunules.

Superior anal appendages seen from above very much as in *annulatus* but longer, as long as segment 10 ; their inner margins, from the tooth, diverging regularly till about one-fourth from the apex where they become parallel for a short space and then again diverge to the acute apex ; outer margin nearly straight ; bases closely approximated. Inferior appendage rather deeply emarginate.

Female.—Abdomen 61 mm. Hind-wing 47 mm.

Similar to the male with few exceptions,—thorax with a small humeral spot ; abdomen with the yellow dorsal marking on segment 2 continued without interruption on the sides

basad ; segments 3 to 7 marked much as in the male ; segment 8 with annule occupying about half of its dorsum ; the annules on segments 3, 4, 5 and 8 interrupted by the black dorsal carina ; segments 9 and 10 obscure.

Wings hyaline with costa clear yellow ; 19-20 antenodal nervures to fore-wings, 14 in the hind of male ; 17 in fore-wings and 12-14 in the hind of female.

Distribution.—A single pair in the Morton collection from Tiflis, Caucasus.

Cordulegaster charpentieri Kol. (1846).

Aeschna charpentieri, Kolenati, *Meletem. Ent.* fasc. V, p. 114 (1846).

Cordulegaster charpentieri, Selys, *Rev. Odon.* p. 298 (1850) ; *Id.*, *Ann. Soc. Ent. Belg.* XXXI, p. 33 (1887) ; *Id.*, *Mon. Gomph.* (sep.) p. 336 (1858) ; Morton, *Trans. Ent. Soc. London*, pp. 280, 281 (June, 1916).

Cordulegaster annulatus race *intermedius*, Selys, *Mon. Gomph.* (sep.), p. 336 (1858) ; Morton, *l.c.* p. 281 (1916).

Cordulegaster pictus, Selys, *Syn. Gomph.* No. 111, p. 87 (1854) ; *Id. Syn. Gomph.* 3rd Addns., p. 43 (1873) ; *Id.*, *Mon. Gomph.* (sep.), p. 340 (1858) ; *Id.*, *Ann. Soc. Ent. Belg.* XXXI, p. 33 (1887) ; Morton, *l.c.* p. 281 (1916).

Cordulegaster bidentatus race *pictus*, Selys, *Mon. Gomph.* (sep.), p. 340 (1858).

Cordulegaster bidentatus race *anatolicus*, Selys, *Syn. Gomph.*, 3rd Adds. p. 65 (1873).

Coll. British Museum, 1 ♀, Anatolia, Brusa ; coll. Selys, 1 ♀, (Type of *pictus*), locality unknown, 1 ♀, (Type of *intermedius*) Dalmatia ; coll. Morton, 1 ♂, Constantinople, 1 ♂, Lagodechi ; coll. Vienna Museum, 1 ♂, 1 ♀, Brusa ; coll. Paris Museum, 1 ♀, locality unknown ; Kolenati's type from Caucasus, a ♂, has been lost.

Male.—Abdomen 57-60 mm. Hind-wing 46-50 mm.

Head.—Labium yellowish ; labrum yellow, its base, sides and the anterior border, more narrowly, black, a tongue-like extension of black from the base nearly meeting that of anterior border ; face yellow, the anteclypeus and anterior border of postclypeus black ; frons yellow with a narrow transverse black stripe just below crest, variable in thickness and sometimes very reduced ; vertex black ; occiput yellow surrounded with black, sometimes black at its middle and fringed with black or dark brown hairs, whilst behind it is yellow with a median black line ; eyes bottle-green as for *annulatus*, the white border behind considerably broader than in *annulatus*.

Prothorax and thorax not differing from *annulatus*. Legs black.

Wings as for *annulatus ;* cubital nervures $\frac{2-2}{2-2}$; all discoidal cells traversed once, all supratriangles entire ; membrane and costa as for *annulatus* ; nodal indices—$\frac{11-18}{11-12}\Big|\frac{19-11}{12-11}$ (type of *intermedius* and paratype male of *pictus*, Selysian coll.), $\frac{11-19}{12-14}$ (*charpentieri* Morton), $\frac{16-18}{16-14}\Big|\frac{18-14}{14-17}$ (*pictus*, Brusa, male, Vienna Mus.), $\frac{11-19}{10-14}\Big|\frac{19-12}{12-11}$, $\frac{11-18}{11-11}\Big|\frac{16-11}{12-12}$; supratriangles $\frac{1-1}{1-1}$, $\frac{1-1}{1-1}$; cubital nervures $\frac{2-2}{2-2}$ (*pictus*, Kaketia, and Elizabethopol, Selysian coll.). Loop 5 to 7 cells, anal triangle 4-5 cells as in *annulatus*.

Abdomen very similar to *annulatus*, differs slightly according to locality. The Selysian males of *pictus* from Kaketia, and *intermedius* from Dalmatia respectively, have the greater part of segment 1 yellow whilst the male *pictus* from Brusa has it largely black, segment 2 in all specimens of *pictus*, *intermedius* and *charpentieri* have the subbasal band strongly

indented behind on the middorsum, the yellow being prolonged back apicad on each side of the notch to split up the black partially, so that, as Morton remarks, the black here is trilobate; the apical lunules on this segment as for *annulatus ;* the dorsal rings on segments 3-7 are distinctly broader than in *annulatus*, in *pictus* Selys and *charpentieri* Morton, from Kaketia, and of about the same width in *intermedius* from Dalmatia, whilst the markings on segment 8 are indented on the apical border as in *annulatus* in the Kaketia and Brusa material, and cleanly defined in *intermedius*. The apical lunules are only found as far as segment 3 in *intermedius*, and as far as segment 5 in *pictus* from Brusa and *charpentieri* from the Caucasus, the former also exhibiting a pair of basal spots on segment 9.

Anal appendages very similar to those of *annulatus*, rather longer and more tapered, the apices curling up and curled slightly inward, more divergent than in *annulatus*. Inferior appendage with sinuous sides and hinder margin almost straight.

Genitalia not differing markedly from *annulatus*.

Female.—Abdomen 57-66 mm. Hind-wing 49-54 mm.

Much more robust than the male and the yellow markings on the whole more extensive.

Labrum more broadly bordered around with black ; clypeus blackish brown ; frons with a cloudy brownish transverse stripe below crest, but no obvious basal black above nor against the eyes ; occiput yellow behind, dark brown in front, no black spot behind, fringed with yellow hairs.

Medio-lateral stripe on thorax split up into three equal spots.

Wings hyaline, venation somewhat variable,—the type of *pictus*, a female in the Selysian collection, has the supratriangles entire in allw ings ; nodal index— $\frac{17-22}{15-13}\Big|\frac{21-16}{14-17}$, 2 cubital nervures in all wings, 8 to 11 cells in the loops, discoidal cells traversed once in three wings, divided into 3 cells in the right fore-wing ; pterostigma black, 4 to 4·5 mm. in length, over $3\frac{1}{2}$ to 6 cells, the primary antenodal nervures are the 8th and 9th in the fore-wings, and the 6th and 7th in the hind. A female in the British Museum, determined by the late Mr. H. Campion as *charpentieri*, and a replica of the Selysian type as regards its markings, has the discoidal cells traversed once in all wings, supratriangles traversed once in all wings except the left hind-wing, which is (as normally) entire, 3 cubital nervures in the left fore-wing, 2 in all the others, 8 cells in both loops, nodal index ? The paratype female of *intermedius* in the Selysian collection has the discoidal cells traversed once in all wings, supratriangles traversed once in all wings except the right fore-wing which is entire, cubital nervures in fore-wings 2 to 4, 2 to 3 in the hind, nodal index ?, anal loops 8 to 9-celled. Lastly a fourth female in the Vienna Museum from Brusa has the venation as follows :—nodal index— $\frac{14-21}{14-15}\Big|\frac{20-14}{17-14}$, cubital nervures 3 in the fore-wings, 2 in the hind, discoidal cells two-celled in all wings except the left fore-wing which has 3, supratriangles entire in all wings except the left hind-wing which has one traversing nervure, anal loop 9 to 11-celled.

Abdomen black marked with yellow as in the male but the rings much broader. Segment 1, in the British Museum specimen, entirely yellow, in the other three specimens brownish black with the sides broadly yellow, segment 2 with a very broad oblique transverse stripe, extending right up to base in the British Museum specimen, and nearly so in the Vienna female, the sides also broadly yellow basad, the lunules very much as in *annulatus*. Segment 3 with the yellow ring covering rather more than one-third of the dorsum, whilst on segments 4 to 6 it covers about one-third and is produced as a short point basad along the

middorsal carina ; segments 7 and 8 have the rings about one-fourth the length of dorsum, segment 9 with a baso-lateral spot on each side, 10 unmarked.

Vulvar scale 9 to 11 mm. in length, yellow laterally at the base.

Distribution.—Very few specimens of this fine insect are known ; I have been able to examine all five of the known females, the type of which, under the name of *pictus*, is in the Selysian collection, with unknown locality, but which Selys thought at one time might have come from India. This was an obvious error, probably due to failure to label at time of capture. Of the other four specimens, one reposes in the British Museum, and bears a label in Campion's handwriting,—" Anatolia, Brusa, Asia Minor, 6th July 1922, P. P. Graves coll. det. Camp.," another in the Selysian collection is from Dalmatia, and although labelled in the Selysian handwriting " bident. S.," is I feel sure, the " enormous " female of *intermedius* mentioned by Selys in the Mon. Gomph. (sep), p. 336 (*Cette femelle est enorme ; aucune autre n'en approche*). A fourth female is in the Vienna Museum and I have to thank Dr. Zerny for the opportunity of examining it, whilst a fifth reposes in the Paris Museum. All five are marked exactly alike, differences only exist in the venation.

As regards the males, Mr. Morton has described one from Lagodechi, Kaketia, and two from Constantinople, now in his collection, under the name *charpentieri*. These differ *inter se* by the frontal marking, in one of which it is absent and in the others heavily defined ; the dorsal abdominal rings differ somewhat in thickness, that on segment 2 being broader, whilst the remainder are narrower than in the Kaketia males ; the lunules are evident up to segment 7. Kolenati's type, a male, is from the Caucasus, and is apparently lost, so that one can not definitely say what the true *charpentieri* was. The description, although short, tallies very well with any of the males which I have had the opportunity of examining, and I do not doubt that both *pictus* and *intermedius* are conspecific with *charpentieri*, although there are some who may not agree with me as far as the latter subspecies or race of *annulatus*, as it was described by Selys, is concerned.

The two males in the Vienna Museum are labelled " Mann. Brusa.," and " *bident.* det. Brauer *pictet*, Hagen." Brauer apparently took these to be *bidentatus*, whilst Hagen may have meant " *pictus*." I can not but think that this set of three insects belongs to a common species as they all come from a common locality.

The type of *intermedius*, a male in the Selysian collection, has no less than three labels in Selys handwriting, which shows that considerable doubt existed in the mind of the author. One bears " Dalmatia," with " *bidentatus* " erased above it ; the second label bears, " *pictus* S.," whilst the third again, " *Cord. pictus* Selys." The locality on the label is that from where the type of *intermedius* was derived, and serves to link up *pictus* with the latter as associated by Selys himself. There is a pair in the Paris Museum, the markings of the male of which are similar to those of the male in the Vienna Museum, whilst the female (abdomen missing) is exactly similar to the type female of *pictus*. Both these insects are from Brusa and bear labels in the Selysian handwriting, " *C. pictus*."

The species appears to be restricted to Western Europe and Asia Minor.

Cordulegaster bidentatus Selys (1843).

Cordulegaster bidentatus, Selys, *Bull. Acad. Roy. Brux.* X, No. 8, (sep.) pp. 7 and 8 (1843) ; *Id., Ann. Soc. Ent. France*, April (1843) ; *Id., Rev. des Odon.* pp. 108, 109 (1850) ; *Id., Bull. Acad. Belg.*

XXI, (2) p. 106 (1854) ; *Id., Mon. Gomph.* pp. 339 to 342 (1857) ; *Id., Bull. Acad. Belg.* (2) XXXVI, p. 509 (1873) ; *Id., Ann. Soc. Ent. Belg.* XXXI, p. 34 (1887) ; Kirby, *Cat. Odon.* p. 81 (1890) ; Calvert *Proc. Acad. Nat. Sci. Phil.* p. 152 (1898) ; Morton, *Trans. Ent. Soc. London,* Parts III and IV, pp. 281 to 284 (June, 1916) ; Fraser, *Journ. Bombay Nat. Hist. Soc.* XXIX, pp. 43 and 44 (1923).

Cordulegaster annulatus (pars), Selys, *Mon. Lib. d'Eur.* pp. 96 and 97 (1840).

Coll. Selys, several of both sexes, only a few of which bear locality labels, Switzerland, Liege, Friedrichsberg and Pyrennees ; coll. Paris Mus., several of both sexes from Basses Alpes and Pyrennees ; coll. Morton, several of both sexes from Digne, Basses Alpes, Mostar in Herzegovina, Switzerland ; coll. Fraser, one pair from Digne, Basses Alpes ; examples in most of the European collections.

Male.—Abdomen 50 to 56 mm. Hind-wing 42 to 45 mm.

Head.—Labium yellow, unmarked ; labrum yellow finely bordered with black and with a tongue-like prolongation extending from the middle of basal black but not reaching anterior border ; anteclypeus black ; postclypeus and frons bright citron yellow, the latter with a short black line on the anterior surface of crest and a very fine black basal line above ; eyes bottle-green ; occiput black fringed densely with coarse yellow hairs and with two confluent yellow spots behind ; behind eyes yellow bordered with black above.

Prothorax brownish black spotted with yellow on dorsum and sides.

Thorax black marked with bright citron yellow as follows,—cuneiform wedge-shaped antehumeral bands with broader ends above, 2 lateral oblique stripes on the sides with a vestigial narrower band between them usually reduced to an upper spot or two small upper spots, tergum spotted with yellow and small spots at roots of wings.

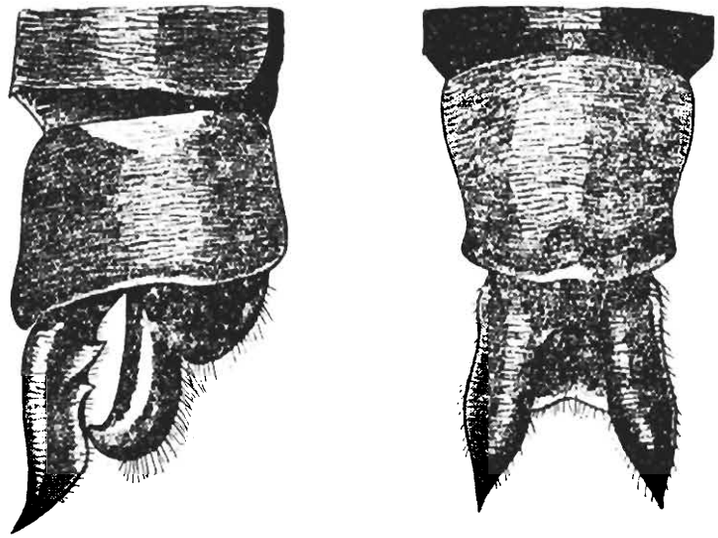
Legs entirely black.

Wings hyaline ; pterostigma black, narrow, covering 3 to 4 cells ; costa black or finely yellow between the node and pterostigma : anal triangle almost always of 3 cells, rarely 4-celled ; nodal index—$\frac{14-16}{16-12}\Big|\frac{17-15}{12-16}$; $\frac{16-19}{14-14}\Big|\frac{19-15}{15-17}$; $\frac{13-17}{13-12}\Big|\frac{18-13}{14-12}$; $\frac{12-18}{13-13}\Big|\frac{20-13}{12-13}$; cubital nervures 2 to 3 in fore-wings, 2 in the hind ; 7 cells in the loop ; supratriangles usually untraversed, occasionally once in the hind-wing ; discoidal cells usually traversed once, occasionally entire.

Abdomen black, marked with citron yellow as follows,—segment 1 with a lateral spot descending nearly to ventral suture ; segment 2 with a narrow dorsal annule extending forwards to embrace the oreillets on the sides but often nearly separated from the latter, a pair of apical dorsal lunulès and a small triangular apico-lateral spot on the ventral border; similar dorsal annules on segments 3 to 8, all finely interrupted on the dorsal carina, and all extending basad on the sides to reach the ventral border. On the carina these annules more or less deeply notched apicad, whilst that on segment 8 often bears a small notch on either side on its apical border. Segment 9 with a small basal subdorsal spot on either side, segment 10 unmarked. Apical lunules found variably on segments 3 to 5, rare on the latter. The annules continued on the ventral surface, especially on segments 7 and 8, much narrower than those seen in *annulatus,* usually occupying not more than one-sixth of the segments.

Anal appendages. Superiors approximated at base, markedly divaricate, as long as segment 10, narrow at base, then expanding rather abruptly at which point they are furnished

with a very robust ventral tooth, narrowing again they taper gradually to an acute apex. At the basal side of the middle of appendage and on its inner aspect, a second ventral tooth



TEXT-FIG. 14.—Anal appendages of *Cordulegaster bidentatus* Selys, ♂.

directed towards the base of appendage, *both teeth being visible in profile view* of appendages. Inferior appendage about three-fourths the length of superior, longer than broad, not appreciably emarginate at apex, on the upper surface of which are seen two minute teeth.

Genitalia not differing appreciably from that of *annulatus*.

Female.—Abdomen 55 mm. Hind-wing 48 to 50 mm.

Very similar to the male but differing in the following respects,—the black much more extensive on labrum, the median basal prolongation confluent with the anterior border so as to split up the yellow ground colour into two large spots, in some examples the black not quite confluent so that the yellow assumes a horse-shoe shaped spot. The yellow annule on segment 8 reduced to a narrow yellow line on each side ; the yellow spot on the sides of vulvar scale, seen in *anulatus,* absent in this species.

Abdomen shaped as for *annulatus ;* vulvar scale 9·5 mm. long.

Wings hyaline, venation as for male but nodal index rather higher and cubital nervures in forewing usually 3 in number ; loop 9-celled.

Distribution.—Not yet fully worked out, confined so far to west and southern Europe. The example described by Calvert is undoubtably a specimen of *C. brevistigma.* I have received a number of the latter species from Kashmir and, noting how closely they resemble *bidentatus,* am able to appreciate the error made. The two species are undoubtedly very closely allied. Morton considers that *bidentatus* may be extending to Asia Minor and it has been reported from Herzogovina. With regard to two specimens, a male and female, from Sicily in the Selysian collection, labelled as *bidentatus,* the broad expanse of the yellow annules on the abdomen raises some doubt as to the correct placing of the insects. In the male, the dorsal markings of segment 2 are almost identical to those of *algiricus,* being almost double the width of typical *bidentatus,* the annule on segment 8 is decidedly broader although widely interrupted, the basal marking on segment 9 is more pronounced and segment 10 has the greater part of the dorsum yellow, enclosing an apical, crown-shaped spot and two tongue-like basal black spots. All annules are broader than in typical *bidentatus* but on the other

hand the occiput is black, the anal appendages are typical of *bidentatus* and the anal triangle is 3-celled. These last three characters are so weighty as evidence, that I prefer to regard the specimen as a race of *bidentatus* bearing the same relation to the latter as does *immaculifrons* to *annulatus*. More material, however, is needed to decide this point.

The female presents more difficulties, as the labrum is not bordered with black. The occiput is black and there is a heavy bar of black across the front of frons. The anal loop of hind-wings is unusually small, being only 6-celled as in the males of *bidentatus*. The markings are broader than in typical *bidentatus*, so that it may well be the female of the male described above. If it were not for the presence of this male, however, one might well consider the possibility of the female being *charpentieri*.

The male has the abdomen 57 mm. in length, the hind-wing 44 mm., 2 cubital nervures in all wings ; anal loop 4 and 5-celled ; supratriangles entire ; nodal index—$\frac{15-17}{14-13}\Big|\frac{16-14}{14-15}$; all discoidal cells traversed once.

This race might well be called *bidentatus sicilicus*.

Cordulegaster insignis insignis Schneider (1845).

Cordulegaster insignis, Schneider, *Ent. Zeit. Stettin*, April-May (1845) ; Selys, *Rev. des Odon. Eur.* pp. 296 to 298 (1850) ; *Id.*, *Bull. Acad. Belg.* (2) XXI, p. 106 (1854) ; *Id.*, *Mon. Gomph.* pp. 343 to 345 (1858) ; *Id.*, *Ann. Soc. Ent. Belg.* XXXI, p. 34 (1887) ; Kirby, *Cat. Odon.* p. 80 (1890) ; Morton, *Trans. Ent. Soc. London*, parts III and IV, pp. 284 to 286 (1916).

Coll. Selys, 1 ♂ labelled "M. Asia" and "Mesopotamia in Malatia" ; coll. Berlin Museum, 2 ♂ and 2 ♀ from Syria ; coll. Schneider, Breslau, 1 ♂ from Kellemisch, Asia Minor ; coll. Morton, 1 ♂ Asia Minor, (Taurus Mts. ?).

Male.—Abdomen 58 mm. Hind-wing 46 mm.

Head.—Labium yellow ; labrum yellow narrowly bordered with brown on anterior border, without median basal tongue of black ; anteclypeus brownish, postclypeus and frons entirely pale yellow, the latter very broadly and shallowly excavate ; occiput markedly tumid behind, pale yellow fringed sparsely with short yellow hairs ; eyes bottle-green, behind creamy yellow bordered with black above.

Prothorax black with a broadly interrupted posterior yellow line on dorsum, an interrupted median line between which are two minute dots, finally a narrow anterior collar of yellow.

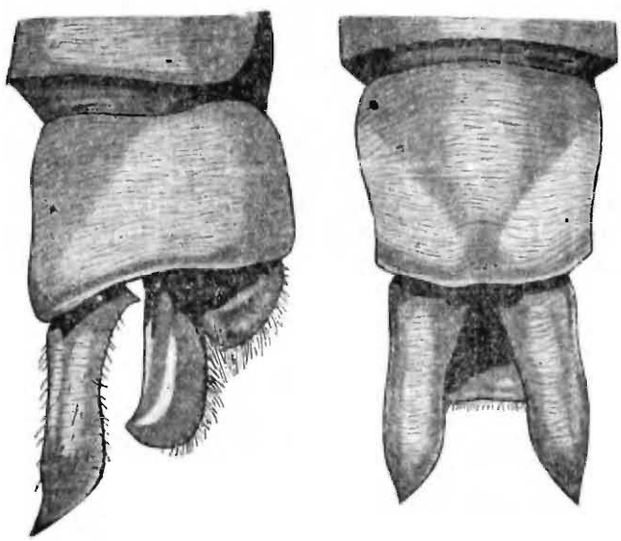
Thorax black marked broadly with pale greenish yellow as follows,—antehumeral wedge-shaped bands as in *annulatus* but much broader, two oblique fasciae on the sides, the hinder of which covers nearly the whole of metepimeron ; a narrow interrupted upper line between the two last, small spots at roots of wings and the tergum broadly.

Legs black.

Wings hyaline ; pterostigma black, 3·5 mm. in length, covers 3 cells, longer in hind-wing than fore ; anal triangle 3-celled as in *bidentatus* ; 2 cubital nervures in all wings ; discoidal cells traversed once, rarely entire ; nodal index—$\frac{10-15}{10-13}\Big|\frac{18-9}{13-10}$; loop 4-celled ; supratriangles entire. Membrane white. Costa margined with yellow.

Abdomen black marked with bright yellow as follows,—a large spot on sides of segment 1 ; segment 2 with a broad annule covering nearly one-third of the segment, notched medially apicad by the black, broadening laterally and covering whole of oreillets, a pair of apical

lunules which may be confluent over dorsum ; segments 3 to 7 with very broad rings, occupying nearly half the length of 3 and 4, less so on segments 5 and 6, forked and notched behind on the latter ; segment 7 relatively narrower, notched basad and markedly forked apicad ; on segment 8 a narrower ring usually broadly interrupted on the dorsum and presenting a small notch on each side apicad ; segments 9 and 10 with a large spot on each side, the latter segment often with the whole of sides yellow.



TEXT-FIG. 15.—Anal appendages of *Cordulegaster insignis insignis* Schn. ♂.

Anal appendages black. Superiors widely separated at base, furnished with a robust outer basal and an inner medial tooth both sloping towards base of appendage, very similar to *bidentatus*. Inferior appendage short, subquadrate, nearly as long as broad, tapering ever so slightly apicad and slightly emarginate at apex, where are seen on the upper surface two small bifid teeth.

Genitalia not differing to any appreciable extent from *bidentatus*.

Female.—Abdomen 57 to 62 mm. Hind-wing 47 to 49 mm.

Differs in some respects to the male. The labrum is markedly bordered with black, the base rather broadly, the anterior border narrowly ; the frons bears a narrow transverse black stripe on the front of its crest ; the anteclypeus black and surmounted by two black prolongations which pass on to the postclypeus ; the base of upper surface of frons narrowly black ; the thoracic bands are broader than in the male ; the abdominal markings are generally broader but there is no yellow basal markings on vulvar scale as in *annulatus*.

Distribution.—Asia Minor and probably from S. E. Europe ; the species has been reported from Roumania. The male reported by Mr. Morton has the markings decidedly more restricted than in the type ; the dorsal annule on segment 2 is not broader than in *annulatus immaculifrons*, but those on the other segments are markedly broader and those on segments 6 and 7 are characteristically bifid apicad. Segment 10 has no markings whatever unless they have been lost from decomposition. The nodal index is lower.

Cordulegaster insignis amasinus Mort. (1916).

Cordulegaster insignis race *amasinus*, Morton, *Trans. Ent. Soc. London*, parts III and IV, p. 286 (June 1916).

Cordulegaster insignis, Selys, *in litt.*

Coll. Selys, 2 ♂ Amasia ; coll. Morton, 4 ♂ 2 ♀ Amasia ; coll. Williamson, 1 ♂ Amasia ; coll. Paris Museum, 2 ♀ 1 ♂ Amasia.

Male.—Abdomen 52 mm. Hind-wing 40-41 mm.

Head.—Labium, labrum, ante- and post-clypeus, and frons all pale yellow without markings ; eyes bottle-green, pale yellow behind with an upper black bordering ; occiput tumid, pale yellow fringed sparsely with short yellow hairs.

Prothorax black marked with greenish-yellow as follows,—the whole of posterior lobe except for a small median black spot, a large lateral spot on each side of middle lobe and a minute geminate spot between them.

Thorax as for type, the whole of metepimeron greenish-yellow except for a narrow posterior black border. Legs black.

Wings hyaline ; membrane white ; pterostigma black, over about 3 cells, the hinder pterostigma the larger ; 2 cubital nervures in all wings ; supratriangles entire ; discoidal cells nearly always entire, occasionally 2-celled ; anal loop 4-celled ; anal triangle 3-celled ; nodal index—$\frac{10-17}{10-10}\Big|\frac{14-8}{12-8}$; $\frac{11-16}{9-10}\Big|\frac{14-9}{10-8}$.

Abdomen.—The yellow markings so extensive that they preponderate over the black,—segment 1 with a complete dorsal annule, broad above, tapering down on the sides and almost reaching the ventral border ; segment 2 bright yellow traversed by a narrow angulate black annule which has a pointed basal medial prolongation on dorsum, narrows subdorsally and then expands again widely on the sides ; segment 3 yellow, its base finely black, its apical end with a narrow black annule broadening laterally ; segments 4 and 5 black with a broad median yellow annule occupying at least one-third of the segments, the dorsal carina indenting them basad and apicad ; segments 6 and 7 somewhat similar but the annules at least half the length of segments and the apical border of annule on 7, 4-pointed apicad ; on segment 8 the annule basal, occupying half the segment, finely divided by the dorsal carina and with a minute notch on the apical border each side ; segment 9 with a baso-lateral triangular spot on each side and a small triangular apico-lateral ; segment 10 variable, usually with a narrow linear spot on each side, or two small spots on each side. The yellow annule on segment 1 also very variable, the dorsal part often broken up into one or more spots. All segments from 2 to 8 with a pair of apical lunules.

Anal appendages similar to *insignis*-type but the middle inner tooth of superiors barely visible in profile, the apices curled up evenly at tips. Genitalia as for *bidentatus*.

Female.—Abdomen 60 to 63 mm. Hind-wing 48 to 50 mm.

Not differing from the male except that there is a trace of the frontal black line seen in *bidentatus* and the anteclypeus is slightly marked with brown. Venational details similar.

Distribution.—Actual distribution unknown, appears to be confined to Amasia and the Kurdish country near Mosul. In one of the females in the Paris Museum, the occiput is black in front, pale yellow behind, the frons has the slightest clouding of black, the labrum is finely bordered with black but there is no median basal tongue. This specimen is remarkably small. The other female has the labrum more heavily bordered with black and there is a slight median brown tongue projecting from the basal black ; the yellow on segment 1 is reduced to a lateral spot, the basal marking on segment 8 is triangular and confluent with a triangular apico-lateral spot ; there is a figure-of-7 marking on each side of segment 9 and the sides and apical borders of 10 are narrowly yellow.

The male does not differ from the above description of the male but the annule on segment 1 is widely interrupted on the middorsum.

Another female in this collection is marked " Mardin," a locality I am unable to place. This specimen may be referred to *amasinus*, differing only in the markings of the end segments, segment 10 bearing two dorsal elongate spots.

Cordulegaster insignis nobilis Mort. (1916).

Cordulegaster insignis race *nobilis*, Morton, *Trans. Ent. Soc. London*, parts III and IV, pp. 286 and 287 (June, 1916).

Cordulegaster nobilis, Selys, *in litt.*

Coll. Selys, 1 ♀ Persia : coll. Morton, 2 ♂ 2 ♀ Van, Asia Minor ; coll. Paris Museum, 1 ♀ Shiraz, Persia ; coll. Indian Mus., 1 ♂ 1 ♀ Shiraz, Persia, May 1871. (These latter specimens have unfortunately since been destroyed in the post in transit to New Zealand to Dr. Tillyard.)

Male.—Abdomen 50 to 52 mm. Hind-wing 41 to 44 mm.

Labium, labrum, postclypeus and frons pale yellow, quite unmarked, anteclypeus blackish brown. Occiput yellow fringed with yellow hairs.

Prothorax black marked with yellow as follows,—the posterior lobe all yellow but partially divided by a narrow wedge of black ; the outer angles of the posterior lobe, a subdorsal spot on each side of middle lobe and a tiny point between them.

Thorax as for *amasinus*.

Wings hyaline, costa markedly yellow ; membrane white ; pterostigma black, over 3 to 4 cells ; venational details as for *amasinus ;* nodal index— $\frac{10-14}{12-11} \Big| \frac{15-10}{11-11}$

Abdomen with the yellow markings even more extensive than in *amasinus*, the greater part of most segments yellow. Segment 1 unmarked or bearing a small central dorsal spot ; segment 2 with a black annule very similar to that of *amasinus* but its basal border markedly crenulate and the lateral expansions almost separated from the dorsal portion ; annules on segments 3 to 6 occupying quite two-thirds of dorsum and prolonged basad laterally to the ventral border ; segments 7 to 9 with dorsal figures-of-7 which face one another, and on 7 are confluent broadly as to their heads, thus enclosing a trilobed black spot on the apical half of segment ; the heads of the 7-like marks on segments 8 and 9 separated by the black of dorsal carina, finely on the former, broadly on the latter ; segment 10 with its sides rather broadly yellow.

Anal appendages similar to those of *amasinus*.

Female.—Abdomen 60 to 61 mm. Hind-wing 46 to 48 mm.

Similar to the male but the markings even more extensive, especially the abdominal which show a bewildering variety. In one from Shiraz, in the Paris Museum, the 1st segment has the base narrowly black, the apical border with a lace-like tracery of yellow ; segment 2 is entirely yellow save for a transversely elongate diamond-like mark on the dorsum of apical half of segment ; segments 3 to 6 have a narrow basal black ring and a broader apical, the latter forming a cordate spot of black on dorsum when viewed from above, the apex of spot pointing apicad ; segments 7 and 8 have each a dorsal trilobate mark, subapical in the case of the former segment but resting broadly on the apical border of the latter segment

and shaped like a broad-arrow ; segment 7 has the base narrowly black ; segment 9 has the middorsum obscure and a basal subdorsal tongue of black on each side ; segment 10 has the apex broadly yellow.

The female from Persia in the Selysian collection is more heavily marked with black,—segment 1 has a transverse yellow dorsal stripe ; segments 2 to 6 are marked very similar to the type male ; segment 7 differs markedly in having a simple broad band bifid apically and each bifurcation again bifid ; segment 8 has a broad lateral stripe on either side enclosing a pyriform black spot which extends from base to apex of segment ; segment 9 has the sides broadly yellow, the dorsum obscure, whilst segment 10 is entirely yellow save for a medial basal black spot bifid apicad and two small subdorsal apical black points.

A female from Astrabad, Persia, shows again marked variations as follows,—segment 1 has a large lateral spot and a medial dorsal ; segment 2 is similar to the female in the Paris Museum from Persia, but the diamond spot is confluent with lateral black spots by its extreme lateral points only ; segments 3 to 6 have the yellow rather more reduced than in the specimen just referred to ; segment 7 is black with a large middorsal cordate spot with a bifid apex ; segments 8 to 10 are similar to the female from Persia in the Selysian collection but the pyriform black spot on 8 is more quadrate and just falls short of the base of segment. How far these variable females belong to *nobilis* it is impossible to say without further material; it is probable that they are mere local variations, though remarkable ones.

Wings hyaline, venational details very similar to those of *amasinus ;* cubital nervures 2 in all wings ; all supratriangles entire ; discoidal cells in all wings 2-celled ; anal loop 6 to 7 cells ; nodal index—$\frac{10-14}{9-9}\Big|\frac{16-9}{10-10}$; $\frac{11-18}{11-13}\Big|\frac{17-13}{13-13}$. Vulvar scale 8 mm. long.

Distribution.—Armenia and Persia, probably throughout the mountainous tracts running from the south Caspian through Habadan to Shiraz in Persia.

Cordulegaster insignis coronatus Mort. (1916).

Cordulegaster coronatus, Morton, *Trans. Ent. Soc. London*, parts III and IV, p. 287 (June, 1916).

Coll. Selys, 1 ♂ Ferghano, Majilan, Turkestan ; coll. Morton, 7 ♂ 1 ♀ Kokand, Fergana.

Male.—Abdomen 52 to 55 mm. Hind-wing 42 to 45 mm.

Head.—Labium yellow ; labrum yellow, the base and sides narrowly black, anterior free border narrowly brown, base usually presenting a well-marked median tongue of black ; anteclypeus black; postclypeus yellow with two small black points in confluence with the black of anteclypeus ; frons entirely yellow, its extreme base above finely black ; occiput yellow, fringed with short yellowish hairs, slightly tumid behind, yellow partly divided by a tiny wedge of black ; behind eyes palest yellow bordered with black above.

Prothorax black bordered with yellow anteriorly and on posterior lobe, a geminate yellow median spot, and a subdorsal median stripe confluent with the yellow on posterior lobe laterally.

Thorax black marked with yellow as follows,—the usual large antehumeral wedge-shaped spots, two broad oblique lateral bands, the hinder of which covers the greater part of metepimeron, a narrow interrupted stripe between these two, usually broken up into 3 or 4 small spots ; coxae yellow, small spots at roots of wings and some spots on the tergum.

Wings hyaline, costa markedly bright yellow ; pterostigma black, narrow, the hind longer than the fore, covers 3 to 4 cells ; 2 cubital nervures in all wings ; all discoidal cells and

supratriangles entire ; nodal index— $\frac{8-14}{7-10}\Big|\frac{14-8}{12-10}$; $\frac{9-13}{7-12}\Big|\frac{16-8}{10-8}$; anal loop 5-celled ; anal triangle 3-celled.

Abdomen black marked broadly with citron yellow as follows,—segment 1 ochreous, its extreme base black ; segment 2 with the base finely black, the jugal suture mapped out in black laterally, a crown-shaped black spot on the dorsum of apical half and a lateral spot which may or may not be confluent with the outer corners of latter ; segments 3 to 6 exactly similar to *nobilis*, with a pair of apical lunules, and broad dorsal yellow bands, occupying two-thirds of segment 3, half of segments 4 and 5, less than half of 6 ; segment 7 somewhat similar but the yellow deeply bifid on the dorsal carina apicad and the apical lunules confluent generally ; segments 8 and 9 have the characteristic double 7-spot, the heads of the figures being broadly confluent on segment 8 to enclose a cordate spot, well separated on 9 where the enclosed spot extends from apex to base of segment ; 10 with a U-shaped spot extending round sides and apical border.

Anal appendages black. Superiors separated at base, as long as segment 10, narrow at base, then expanding abruptly, at which point there is a very robust ventral tooth, its point directed basad ; apex finely pointed and slightly upturned ; a submedial ventral tooth as in *bidentatus*, plainly visible from above but hardly so from the side as in *nobilis*. Inferior appendage rather longer than half the superior, slightly longer than broad, tapering gradually to the apex which is slightly emarginate and turned up with a minute tooth on each side.

Genitalia not differing from *insignis*.

Female.—Abdomen 60 mm. Hind-wing 48 mm.

Very similar to the male ; the dorsal spot on segment 2 confluent at each side with the lateral black, the yellow bands on segments 3 and 4 occupying nearly two-thirds of segments, those on 5 to 7 about half the segment ; segment 8 with a large isolated dorsal spot ; 9 and 10 mostly yellow, 9 with the base and sides yellow enclosing a diamond-shaped spot, the apex of which is narrowly separated from base of segment, segment 10 with the base broadly black from which two subdorsal prolongations run out ending in an isolated black point.

Venational details as for male. Vulvar scale 7 mm. in length.

Distribution.—Kokand, Fergana in Turkestan, and Persia. The female in the Paris Museum collection from Astrabad may be a female of this subspecies. It certainly resembles the type male rather closely, but with so much variation and so little material to form ones conclusions on, it is impossible to be dogmatic.

Mr. Morton treats this insect as a distinct species, but it does not seem to me that the differences between it and typical *insignis* are so very much wider than *nobilis* or *amasinus*, so that for the present it is treated as a subspecies or race.

[**Cordulegaster brevistigma brevistigma** Selys (1854).]

Thecagaster brevistigma, Selys, *Bull. Acad. Belg.* (2) XXI, p. 103 (1854) ; Kirby, *Cat. Odon.* p. 79 (1890).

Cordulegaster brevistigma, Selys, *Mem. Soc. Roy. Sci. Liege*, XI, pp. 589, 590 (1858) ; *Id.*, *Mon. Gomph.* (sep.) 329 (1858) ; *Id.*, *Ann. Soc. Ent. Belg.* p. 181 (1894) ; Williamson, *Proc. U. S. Nat. Mus.* XXXIII, p. 277 (1907) ; Fraser, *Journ. Bombay Nat. Hist. Soc.* XXIX, pp. 40 to 42, fig. 5 (1923).

Coll. Br. Mus. 4 ♂ (one of which is the type), 1 ♀ (Saunder's coll.), N. W. India and Kalapani, 7th May 1887 ; coll. Ind. Mus. 3 ♂ Bhaji, Simla Hill Sts. ; coll. Fraser, 3 ♂ 3 ♀ Kumaon, Muktesar, Simla, Darjeeling and Kashmir ; coll. Pusa, several from Muktesar and Kashmir.

Male.—Abdomen 51 to 54 mm. Hind-wing 41 to 42 mm.

Head.—Labium and mandibles pale ochreous ; labrum greenish yellow finely bordered with black and with a small median black tongue extending towards but not reaching anterior margin of lip ; postclypeus greenish yellow, its anterior margin and whole of anteclypeus black with a small prolongation upwards on either side ; frons greenish-yellow with a broad transverse black stripe on the upper half of its anterior surface and moderately broad basal black bordering to its base above ; vesicle black ; occiput small, not tumid, black fringed with yellow hairs and with a large spot of yellow behind ; eyes bottle-green, yellow behind with an upper broad border of black.

Prothorax black marked with a yellow basal annule, a large spot of yellow on each side of the middle lobe, and the whole of posterior lobe except its centre.

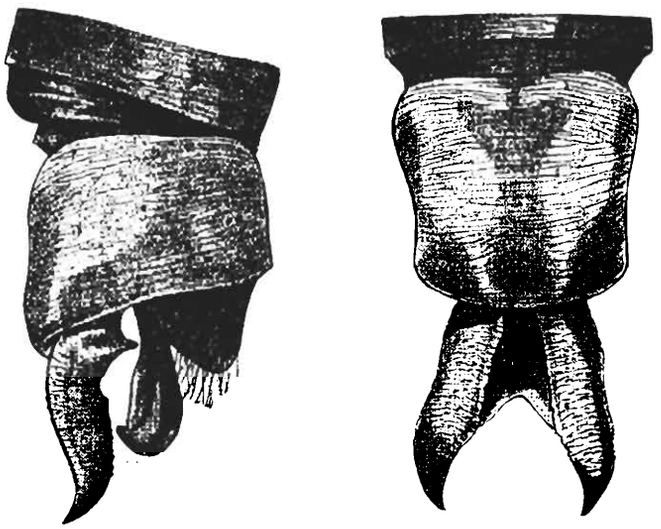
Thorax black, coated with short shaggy whitish hairs, marked with greenish-yellow as follows,—wedge-shaped antehumeral bands nearly confluent above which part is the broader, two narrow oblique bands on the sides and an interrupted band between them consisting of three small spots. A small spot at the base of each wing and some spots on the tergum.

Legs black.

Wings hyaline with a somewhat pale greenish tinge at bases and along costa, which latter is finely yellow throughout its whole length. Membrane white ; pterostigma black, narrow, covering about 2 to 3 cells, 3 to 4 mm. in length ; anal triangle 3-celled ; cubital nervures 1 in all wings ; nodal index— $\frac{9-14}{11-11}\Big|\frac{14-10}{11-8}$; $\frac{11-17}{12-13}\Big|\frac{20-11}{11-11}$; discoidal cells 2-celled or entire ; anal loop 5 to 6-celled.

Abdomen black marked with citron-yellow as follows,—segment 1 usually with a small lateral spot, sometimes also two small comma-like spots on dorsum or with baso-lateral spots, rarely immaculate ; segment 2 with a pair of apical lunules more or less confluent across the dorsum, a second pair of lunules bordering the apical side of jugal suture and more or less confluent across the middorsum, the oreillets, and occasionally a small lateral spot basal to them. Between the two pairs of lunules the black of variable width, with angulated borders and constricted outwardly so as to be, in some specimens, nearly cut up into lateral and middorsal spots ; segments 3 to 7 with apical lunules confluent on 3, 4 and 5, separated on 6 and 7 ; a pair of middorsal spots narrowly separated by the finely black dorsal carina on each of these segments, usually more widely separated on segment 7 than on the others ; segments 8, 9 and 10 all very variably marked as in most other species ; segment 8 usually with a narrow dorsal annule, divided by the dorsal carina and lying nearer base than the annules on other segments, each half of the ring occasionally notched apicad ; in some specimens a pair of apical lunules more or less obsolete ; segment 9 usually with a small baso-lateral angulated spot, deeply notched on its inner aspect ; segment 10 with a narrow basal ring (Kashmir specimens) or with an elongate basal subdorsal spot on each side (Kumaon specimens), or with a baso-lateral spot and a pair of middorsal basal spots (Simla specimens) ; segment 9 in Kashmir examples has a pair of figures-of -7, the heads widely separated, which seem to be formed by a conjunction of a baso-lateral spot with an apical obsolete lunule ; in the Simla specimens there are occasional apical obsolete lunules.

Anal appendages black. Superiors moderately closely apposed at base, divaricate thereafter, apices narrowing rapidly and ending in an acute point ; inner surfaces of appendages



TEXT-FIG. 16.—Anal appendages of *Cordulegaster brevistigma brevistigma* Selys, ♂. From specimen in Fraser collection.

looking upward and inwards so that a median ventral robust tooth is scarcely visible in profile view of appendages ; a robust basal ventral tooth, its apex, as also that of medial reverse tooth, directed sharply basad. Inferior appendage a little more than half the length of superiors, nearly quadrate, its apex emarginate, broadly and shallowly notched, and with a tiny tooth at each upper corner. Genitalia as for *bidentatus*.

Female.—Abdomen 53 mm. Hind-wing 45 mm.

Very similar to the male, differing in the following particulars,—wings saffronated at extreme base as far as the first antenodal in old specimens, as far as the arc in younger, the latter also showing a distinct greenish-yellow tinge of the whole of wings especially along the costal margins ; old examples have the wings evenly but palely enfumed, nodal index—$\frac{13-16}{12-12}\left|\frac{16-12}{12-12}\right.$ $\frac{13-18}{13-13}\left|\frac{16-12}{12-14}\right.$; 1 cubital nervure in all wings ; pterostigma covering $2\frac{1}{2}$ cells, black ; 6 to 9 cells in anal loop ; discoidal cells 2-celled, occasionally 3-celled in the fore-wings.

Labrum slightly more bordered with black ; anteclypeus more pronouncedly black.

Abdomen laterally compressed, ending in a moderately short vulvar scale which is broadly yellow at its base, 6·5 mm. long. Segment 1 variable, with a large apical linear spot and two small comma-like dorsal spots, or the markings reduced to a small apico-lateral spot ; segment 2 usually with a large diamond-shaped isolated spot on apical half of dorsum, but this may be more or less broadly confluent with the lateral black ; a more or less broad subbasal annule bordering the apical side of jugal suture and extending obliquely basad and laterally as far as ventral border ; nearly always a small spot of yellow at the lower apical angles of segment ; segments 3 to 7 with spots slightly larger than in the male, and with that on segment 3 produced obliquely basad and ventralwards as a complete ring, or tapering to a point which just reaches ventral border ; all segments from 3 to 8 with apical lunules ; 9 and 10 are largely yellow, the dorsum of the former with an obscure triangular spot of black, and segment 10 with its base and two small dorsal prolongations black.

Distribution.—The Himalayas from Kashmir to Assam. The exact distribution of this species is very imperfectly known and with more material at our command, it may be possible to define several distinct races. The wide variation in the nodal indices of the two males given above suggests a differentiation into local types. The specimen of *Cordulegaster* mentioned by Calvert, under the name of *bidentatus*, most certainly belongs here ; the two species are so closely allied that the error was justifiable.

Cordulegaster brevistigma folia, subsp. nov.

Male.—Abdomen 48 mm. Hind-wing 42 mm.

Head.—Labium dirty yellow ; labrum citron yellow finely bordered with black and with a narrow sharply-defined medio-basal tongue of black extending about two-thirds towards the anterior border ; anteclypeus black ; postclypeus, bases of mandibles and frons bright greenish yellow, the former with two small submedial points of black, the latter with a transverse stripe of black just below its crest but meeting the crest at its middle part ; frons shallowly and broadly concave above, its extreme base at its middle blackish brown with a crenulate border ; occiput bright yellow framed in black at the sides and fringed with short stiff golden hairs. Behind eyes and occiput yellow with a broad black area extending to border of eyes near occiput.

Prothorax black with a narrow anterior collar and the hinder border of posterior lobe narrowly citron yellow, interrupted at the mid-point of posterior lobe but curving forward laterally to become confluent with a spur of the same colour on each side.

Thorax black marked with citron yellow as follows,—a pair of wedge-shaped antehumeral spots, the outer border of each straight, the inner convex ; a pair of lateral stripes, one on the mesepimeron moderately narrow, the second, about twice as broad, on the anterior part of metepimeron. Between these two stripes a chain of three spots finely connected or slightly interrupted between the two lower. Legs black, armature as for genus.

Wings hyaline, palely enfumed ; 1 cubital nervure to all wings in addition to the one forming base of subtrigone ; 3 cells in anal triangle ; nodal index,— $\frac{11-15}{10-10} \Big| \frac{15-11}{11-9}$; 6 cells in anal loop ; all discoidal cells 2-celled ; supratriangles usually entire but occasionally traversed once.

Abdomen black marked with citron yellow as follows,—segment 1 with a small dorsal basal triangular spot, its apical border dorsally raised into a transverse rounded ridge ; segment 2 with a large basal lateral spot which includes the oreillets and which is only narrowly separated from a transverse stripe on the dorsum nearly interrupted on the middorsal ridge ; a pair of apico-dorsal lunules and an angulated stripe situated at the junction of apical and lateral borders ; segment 3 with two large subdorsal spots broadly confluent over the middorsum and rounded apicad, a pair of apical lunules and a small spot at junction of lateral and basal borders ; segments 4 to 6 similar but the lunules smaller on segment 6 ; segment 7 with the subdorsal spots finely separated by the dorsal carina, narrower and more transversely elongate, the lunules very small ; segment 8 similar to 7 but the subdorsal spots still narrower and the lunules progressively smaller ; segment 9 with a large Z-shaped spot on each side extending from base to apex ; segment 10 with a hook-shaped stripe on each side.

Anal appendages black, similar in shape to *brevistigma*, about equal in length to segment 10, the basal and ventral spines of superiors easily visible from the side but not from above; inferior about two-thirds the length of superiors, flattened above, quadrate, well notched at apical border, the corners furnished with a set of 3 or 4 minute teeth above. Genitalia not differing from the generic type.

Female.—Abdomen including ovipositor 55 mm. Hind-wing 44 mm.

A much more robust insect than the male but marked very similarly. The labium more broadly bordered with black ; the transverse black bar on front of frons broader and edging the crest of frons throughout ; the black basal bordering of frons broader, extending out laterally and with its anterior margin similarly crenulate as in the male ; occiput blackish brown fringed with golden hairs, bright yellow behind as also back of eyes, where is seen a similar but broader black area.

Prothorax and thorax as for male but the antehumeral stripes narrower and their inner border sinuous ; the medio-lateral stripe present as a chain of three very small discrete spots. Legs black.

Wings enfumed and palely saffronated especially at base ; pterostigma black as in the male, short, narrow, covers 2-3 cells ; nodal index,— $\frac{12-17}{12-12}\Big|\frac{17-11}{12-12}$; anal loop 7 to 8 cells ; all supratriangles traversed once ; 1 cubital nervure to all wings ; all discoidal cells 2-celled ; costa finely yellow to beyond node ; membrane white.

Abdomen similar to the male but the dorsal stripe on segment 2 confluent with the latero-basal spot and the apical lunules, so as to include a large spot of the ground colour shaped like a grape leaf, the stalk of which is directed basad ; the medial spots on segment 3 continued as an oblique stripe running basal and ventral ; apical lunules absent after segment 6. Vulvar scale 6 mm. in length, reddish brown, yellow at the base and sides.

Distribution.—Naini Tal, Kumaon, Western Himalayas, *ca.* 7000 ft. On the wing from June. This beautiful species is only likely to be confounded with *brevistigma*, from which it is determined by its larger size, by the spots on the abdomen, which are twice the size of those of *brevistigma*. The beautiful marking on the dorsum of segment 2 of the female is sufficient to determine it at a glance. There are some other differences of less degree but which are noticeable enough when the two subspecies are confronted, thus the shape of the antehumeral stripes and especially the crenulate border of the basal black of frons. This subspecies appears to bear the same relation to *brevistigma* as does *immaculifrons* to *annulatus*.

Type and allotype in the Fraser collection.

Cordulegaster luniferus luniferus Selys (1878).

Cordulegaster luniferus, Selys, *Bull. Acad. Belg.* (2) XLVI, p. 691 (1878) ; McLachlan, *Ann. Mag ; Nat. Hist.* (6) XVII, p. 364 (1896).

Coll. Paris Mus. 2 ♂ 1♀, (one of the former the type), Moupin, Tibet, A. Davies 1876 ; coll. McLach. 3 ♂, East Tibet.

Male.—Abdomen 50-51 mm. Hind-wing 39-41 mm.

Head.—Labium reddish yellow ; labrum yellow broadly bordered with reddish brown and with a medio-basal furrow black traversing its centre ; anteclypeus dark brown ; post-clypeus and frons yellow or ochreous, the latter bearing on its superior surface a large subtri-

angular spot of blackish brown which extends forwards nearly to the crest ; vertex black ; occiput obscurely yellow fringed with black hairs and bearing a large spot of yellow behind ; eyes brown, probably green during life ; behind eyes yellow bordered with black above.

Prothorax black. Thorax black marked with vivid yellow as follows,—a pair of antehumeral stripes, broad above, narrowing and tapering to a point below where they are markedly divergent ; laterally two oblique stripes, one posthumeral, the other covering the central portion of the metepimeron ; occasionally a medial vestigial stripe present made up of three small spots situated between the lateral stripes. Legs black.

Wings hyaline, palely enfumed ; bases of all, as far as the arc, tinted with golden yellow ; costa black ; pterostigma blackish brown, 3·5 mm. in length ; membrane greyish white ; nodal index—$\frac{14-16}{17-13}\Big|\frac{11-14}{13-15}$; discoidal cells traversed once, occasionally entire or traversed twice ; 2 to 3 cubital nervures to all wings, usually only 2 ; 4 cells in anal triangle, 7 in the anal loop.

Abdomen black marked with yellow spots as follows,—segment 1 unmarked ; segment 2 with a pair of small post-jugal dorsal lunules and a pair of apical lunules ; segments 3 to 6 with similar paired spots, the apical pair sometimes absent on 6 ; segments 7 and 8 with only the post-jugal paired spots, very narrow and nearer the base on 8 ; segment 9 with a narrow basal annule tapering towards the dorsum ; segment 10 with a pair of small dorsal basal spots and a larger apico-lateral spot on each side.

Anal appendages closely resembling those of *C. bidentatus*, the superiors with a robust basal ventral spine and an antemedial smaller one ; inferior appendage a third shorter, subquadrate, slightly notched at apex and bearing a small tooth at each corner.

Genitalia similar to that of *C. bidentatus*.

Female.—Abdomen 52-57 mm. Hind-wing 44-47 mm.

Differs somewhat from the male as follows,—the labrum with darker borders ; occiput definitely yellow ; eyes very tumid behind, yellow bordered with black above.

Wings palely tinted with golden yellow at base in the costal and subcostal spaces nearly as far as node, and in the median space as far as discoidal cell ; membrane white ; discoidal cell traversed once or twice ; anal loop with 9 to 10 cells ; supratriangles with 2 or 3 traversing nervures ; 3 cubital nervures in all wings ; nodal index—$\frac{15-19}{16-13}\Big|\frac{17-16}{13-17}$, $\frac{15-17}{15-13}\Big|\frac{19-15}{13-15}$. (One specimen has only 7 to 8 cells in the loop.)

Abdomen with the spots larger on most segments ; segment 2 with the post-jugal spots crescent-shaped and lying rather obliquely ; segment 7 with the spots much larger than on the preceding segments ; segment 8 with the stripe interrupted, broader and subbasal, whilst segments 9 and 10 are unmarked.

Anal appendages small, black, conical ; vulvar scale moderately long, 6 to 7·5 mm. in length, ochreous at base changing to black at apex.

Distribution.—Tibet. McLachlan remarks of this species that it is extremely doubtful whether it is distinct from *C. pekinensis* Selys, an opinion with which I am inclined to agree, the rank not being more than racial or subspecific in value. In my notes made on the type and paratypes in the Paris Museum I note the following,—" Frons markedly raised and projected as in *Allogaster* in which genus I should place it, markings however are those of a *Cordulegaster* rather than the former genus. Oreillets pronounced."

Cordulegaster luniferus pekinensis Selys (1886).

Cordulegaster pekinensis, Selys, *Comp. Rend. Soc. Ent. Belg.* XXX, p. clxxxii (1886) ; McLachlan, *Ann. Mag. Nat. Hist.* (6) XVII, p. 364 (1896).

Coll. Selys, 1 ♂ (type), North China, Pekin ; coll. McLachlan, 1 ♂ 2 ♀ Liao Siao and Mo-si-nuen, Szechuen, E. Tibet.

Male.—Abdomen 54 mm. Hind-wing 42 mm.

Closely resembles *C. luniferus luniferus* of which it is probably but a local race or subspecies, differs as follows :—

Size rather larger ; labrum with borders and mediobasal furrow reddish brown ; frons with base black above ; occiput black fringed with black hairs.

Thorax black marked with bright citron yellow as for *luniferus* but with no medial chain of spots laterally.

Wings hyaline ; membrane white ; supratriangles entire in all wings or traversed in the fore ; discoidal cells only traversed once in all wings, never entire or traversed twice ; regularly 5 cells in the anal loop ; 3, more rarely 2, cubital nervures in all wings ; anal triangle 4-celled ; nodal index— $\frac{17-19}{19-13} \Big| \frac{19-17}{15-18}$.

Abdomen black marked with citron yellow as follows,—segment 1 with a small subdorsal spot on each side ; segment 2 with a baso-lateral spot on each side which includes the oreillet, a post-jugal stripe formed by the confluence of two lunules, and a pair of apical dorsal lunules ; segments 3 to 6 as for *luniferus* but the spots considerably larger ; segments 7, 8, 9 and 10 very similar to those of *luniferus*, but the spot on 7 larger, the stripe on 8 broader and confluent over dorsum, whilst 8 and 9 have small paired apical lunules.

Anal appendages similar to those of *luniferus* (apices fractured off in the type). Genitalia similar but reddish brown and the anterior hamules densely hairy.

Distribution.—China and Tibet. The markings of this species are strongly reminescent of those of *Allogaster annandalei*, a resemblance which is further heightened, as in *C. luniferus luniferus*, by the great height of the frons, so that, when further material comes to hand, it will have to be decided whether these three species are not really conspecific or races of a common species.

[**Cordulegaster maculatus** Selys (1854).]

Cordulegaster maculatus, Selys, *Bull. Acad. Belg.* (2) XXI, p. 105 (1854) ; *Id. ibid.* (2) XLVI, p. 689 (1878) ; *Id.*, *Mon. Gomph.* p. 337 (1858) ; Kirby, *Cat. Odon.* p. 81 (1890) ; Howard, *The Insect Book*, p. 373, pl. xliv, fig. 7 (1902).

Aeschna obliqua var. *A.*, Say, *Journ. Acad. Phil.* VIII, p. 16 (1839) ; Selys, *Mon. Gomph.* p. 339 (1858).

Coll. Br. Mus. 1 ♂ (type), N. America ; coll. Paris Mus. 3 ♂ ; coll. Hagen 1 ♂ Connecticut ; coll. Williamson, 4 ♂ and 1 ♀ Soo, Ontario and Hayden, Ontario ; coll. Fraser, 1 ♂ 1 ♂, from same localities.

Male.—Abdomen 48-50 mm. Hind-wing 38-40 mm.

Head.—Labium pale brown ; labrum pale greenish yellow with the middle concave part of anterior border pale brown, the base finely brown with a short narrow tongue of this colour at the middle extending about halfway to anterior border ; anteclypeus dark brown ;

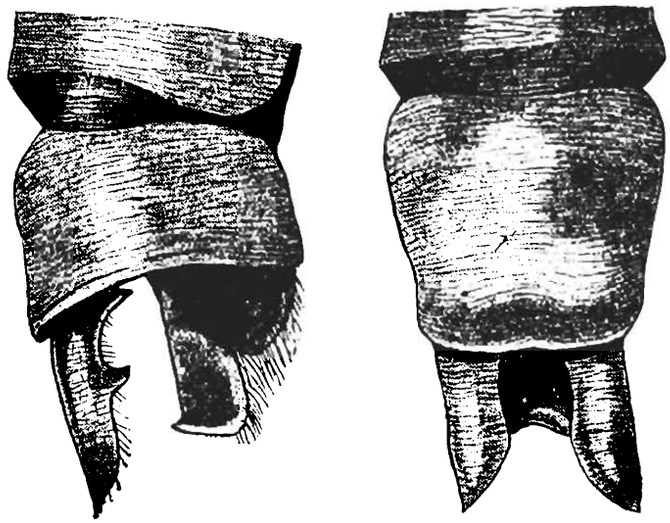
postclypeus and frons greenish yellow, the lower part of former and two small submedian points dark brown, the upper surface of frons anteriorly suffused with pale brown, this deepening to dark brown on the extreme crest ; vertex and occiput blackish brown, the latter with a fringe of long coarse pale brown hairs ; eyes bright yellow behind.

Prothorax and thorax blackish brown, the latter marked with bright greenish yellow as follows,—a pair of wedge-shaped antehumeral stripes broad above, diverging and tapering to a point below ; two narrow oblique stripes on each side, one on the fore part of mesepimeron, the other on central part of metepimeron.

Legs black, hind femora obscurely reddish brown, armature as for genus.

Wings hyaline, palely and evenly enfumed but rather darker at the apices ; costa finely yellow ; reticulation close ; membrane brown ; pterostigma dark reddish brown, narrow, rather short, that of hind-wing rather longer than the fore, covering 3 to $4\frac{1}{2}$ cells ; nodal index,—$\frac{14-19}{11-14}\Big|\frac{18-11}{14-11}$, $\frac{13-15}{12-14}\Big|\frac{18-13}{14-13}$, $\frac{12-20}{14-16}\Big|\frac{19-13}{16-13}$; anal loop 4-7 celled ; (5-celled in one specimen, 6-celled in another, 7 in a third and 4 and 5 in a fourth) ; 2 cubital nervures in fore-wings, only 1 in the hind ; all discoidal cells 2-celled but one fore-wing of the type has 3 cells ; supratriangles usually entire but traversed twice in one fore-wing of the type and once in one of the hind-wings of the same specimen ; anal triangle 4-celled, very rarely with only 3 cells.

Abdomen black marked with citron yellow as follows,—segment 1 brown, yellow at the sides ; segment 2 with a pair of dorsal lunules bordering the apical side of jugal suture, the oreillets and a pair of apical dorsal lunules ; segments 3 to 7 with a pair of subconical dorsal spots rather broadly separated by the middorsal carina, situated slightly basal to middle of segments and occupying slightly less than one-fourth of their length, broader on segment 7 than on the others ; segment 8 with a similar but less conical pair of spots situated much nearer the base, more widely separated and notched deeply on the apical side ; segment 9 with a pair of basal transversely oval spots deeply notched on the apical side ; segment 10 reddish brown, immaculate.



TEXT-FIG. 17.—Anal appendages of *Cordulegaster maculatus* Selys, ♂. From a specimen in the Williamson collection.

Anal appendages blackish brown, the inferior paler. Superiors straight, parallel, apex bevelled outwardly and ending in an acute point in continuation with the outer border,

two robust ventral spines beneath, one basal partly visible in profile view of appendage, the other smaller situated about middle of appendage, strongly imbricated analwards and partly visible when appendages viewed from above. Inferior three-fourths the length of superiors, quadrate, the apex shallowly notched, the corners with a minute tooth above.

Genitalia not differing markedly from genotype.

Female.—Abdomen 58 mm. Hind-wing 49 mm.

More robust than the male, differs in the following respects,—labrum brown with a diffuse spot of greenish yellow on each side situated about midway between the middle point of lip and its outer border, the median tongue of basal brown much broader than in the male and framed with a horse-shoe of diffuse yellow ; crest of frons dark brown and the upper half of anterior surface paler brown ; upper border of eyes behind blackish brown.

Prothorax with a narrow collar of citron yellow anteriorly.

Thorax with a vestigial median yellow stripe between the two lateral ones ; wings more often enfumed especially at apices and along posterior border ; anal loop 7- to 9-celled , supra-triangles occasionally traversed in the fore-wings ; discoidal cells occasionally 3-celled in fore-wings ; nodal index,—$\frac{13-21}{13-16}\Big|\frac{22-14}{16-14}$; 2 cubital nervures in fore-wings, only 1 in the hind ; pterostigma rather longer than in the male.

Abdominal markings less extensive ; segments 9 and 10 reddish brown ; vulvar scale long, inner scales extending beyond the tips of anal appendages, black, reddish brown at base. Anal appendages short, pointed, conical, black.

Distribution.—Manchester, Maine, N. America ; Connecticut ; Stoney Creek, Soo, Ontario, June to August. The exact distribution of this species has yet to be worked out.

Related to *erroneous*, *diadema* and *dorsalis*.

Cordulegaster godmani MacLachlan (1870).

Cordulegaster godmani, MacLachlan, *Ent. Mon. Mag.* XV, p. 35 (1870) ; Selys, *Bull. Acad. Belg.* (2) XLVI, p. 687 (1878) ; Calvert, *Biol. Cent. Amer.* (Neur.) p. 173 (1908) ; Kirby, *Cat. Odon.* p. 81 (1890).

Coll. Selys, 1 ♂ Irazu, 6000-7000 ft., coll. H. Rogers ; coll. MacLach. 1 ♂ with same locality ; coll. U. S. Nat. Mus. 1 ♂ 1 ♀ with same data but the male bearing a label in MacLachlan's handwriting " Type,"—Calv. Omilteme in Guerras Mexico 1 ♂ 1 ♀, Guatemala, Purula in Vera Paz 1 ♂, Azahar de Cartago, Costa Rica 1 ♂ ; coll. Paris Mus. 1 ♂ Mexico (end segments of abdomen missing).

Male.—Abdomen 55 mm. Hind-wing 45 mm.

Head.—Labrum yellow or reddish brown narrowly bordered with brown at the sides ; labium greenish yellow narrowly bordered with brown and with a medio-basal tongue of the same colour ; bases of mandibles yellow ; anteclypeus dark brown ; postclypeus greenish yellow, its central part brownish especially that part adjacent to anteclypeus ; frons dark brown in front and above, immaculate ; occiput variably yellow to brown or even black fringed with short stiff black hairs ; behind eyes golden brown or yellowish.

Prothorax brown, immaculate.

Thorax dark reddish brown marked with citron yellow as follows,—two wedge-shaped antehumeral stripes separated by the middorsal carina above, diverging widely and tapering

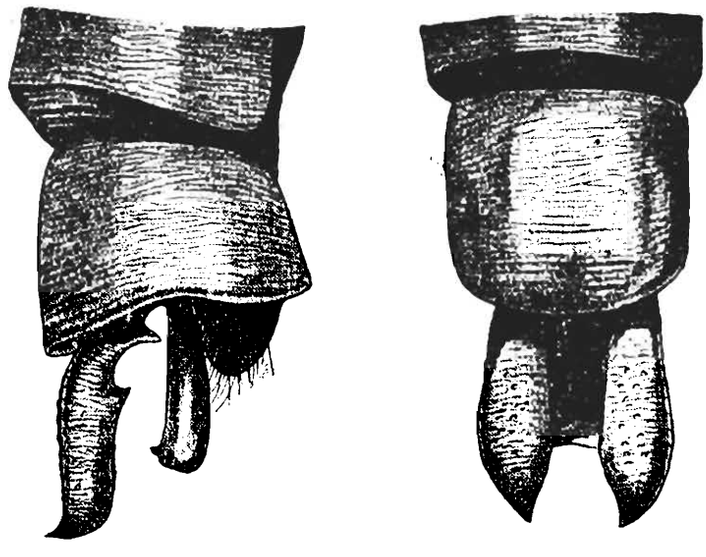
to a fine point below ; two narrow oblique stripes on each side, one on the mesepimeron, the other on the middle part of metepimeron ; a vestigial stripe between these two latter represented by an upper or an upper and lower spot (entirely absent in some specimens).

Legs black, femora reddish brown ; armature as for genus.

Wings hyaline enfumed in adults and tinted with yellow especially at the base ; reticulation close ; membrane cinerous or white ; nodal index, $\frac{17-23}{19-15} \Big| \frac{22-17}{14-19}$, $\frac{13-19}{12-14} \Big| \frac{21-14}{16-13}$; pterostigma black, 3·5 to 4·5 mm. in the fore-wings, rather longer in the hind, covering $2\frac{1}{2}$ to $4\frac{1}{2}$ cells ; 1 to 2 cubital nervures in fore-wings, usually 1, only 1 in the hind ; discoidal cells usually 2-celled but occasionally entire in the fore-wings ; supratriangles entire in the fore-wings, often traversed once in the hind ; anal loop 5-celled ; anal triangle 3-celled.

Abdomen black marked with citron yellow as follows,—segment 1 brown, immaculate ; segment 2 with a middorsal annule narrowed or actually interrupted at its middle, broadening and including the oreillets outwardly, a pair of apical lunules and the ventral border narrowly ; segments 3 to 7 with similar antemedial lunules interrupted narrowly by the middorsal carina, 3 to 6 with apical lunules ; segment 8 with a broad median annule expanding on the sides towards the base, occasionally interrupted on the dorsal carina ; segment 9 with a complete or interrupted basal annule ; segment 10 with a variable basal dorsal marking usually bearing three points apicad.

Anal appendages black, superiors about as long as segment 10, somewhat similar in shape to those of *bidentatus*, the apex pointed, bevelled and turned up ; a robust basal



TEXT-FIG. 18.—Anal appendages of *Cordulegaster godmani* MacLach. ♂. From a specimen in the Williamson collection.

ventral spine and a smaller antemedial one turning back rather sharply towards the anus. Inferior appendage nearly quadrate, tapering but slightly towards the apex, this being from one-half to two-thirds the width of base, slightly notched.

Genitalia not noticeably differing from the genotype, reddish brown including the lobe.

Female.—Abdomen 58 mm. Hind-wing 50 mm.

Closely similar to the male, differing in structural details only. The intermediate lateral stripe on thorax better developed ; wings usually tinted with yellow at base, costa finely

yellow ; brown bordering of labrum more ochreous ; abdominal annules narrower or, in old specimens, entirely obliterated.

Vulvar scale dark brown, black at apex, about the same length as in *diadema.* Anal appendages slender, pointed, black.

Distribution.—Volcano Irazu and Cartago, Costa Rica, Omilteme, Mexico, Guatemala, Mountains of Central America up to 7000 ft.

Related to *maculatus, diadema* and *erroneus.* Calvert gives the following notes, *loc. cit.*,—" Occiput yellow in the pair from Omilteme, black in the Purula male, which also has the labrum reddish brown and the inferior appendage moderately tapered. The pair from Omilteme have no intermediary spots on sides of thorax ; the abdominal rings are interrupted in some but not in all on segments 2, 8 and 9."

Cordulegaster diadema Selys (1868).

Cordulegaster diadema, Selys, *C. R. Soc. Ent. Belg.* XI, p. lxviii (1868) ; *Id., Bull. Acad. Belg.* (2) XXVIII, p. 203 (1869) ; Kirby, *Cat. Odon.* p. 81 (1890) ; Currie, *Proc. Ent. Soc. Wash.* V, p. 303 (1903) ; Needham, *Proc. U. S. Nat. Mus.* XXVII, p. 697 (1904) ; Calvert, *Biol. Cent. Amer.* (Neur.) p. 173 (1908) ; Kennedy, *Proc. U. S. Nat. Mus.* LII, pp. 515-523 (1917).

Coll. Selys, several ♂ ♂ one of which was the type, all specimens since lost, including the type ; coll. Paris Mus. 1 ♂ (without locality) ; coll. Williamson, 1 ♂ Cuernavaca, Mexico ; coll. U. S. Nat. Mus. 1 ♂ Ventanas (Forrer 1 ♂) Sante Fe in the Distrito Federal (4 ♂ 1 ♀), Cuernavaca (5 ♂ 1 ♀) (Barrett, coll. P. P. C. ; coll. MacLach. 1 ♂) Orizaba.

Male.—Abdomen 57-64 mm. Hind-wing 43-48 mm.

Head : labrum bright yellow ; labium bright citron yellow, the concave portion of anterior border narrowly pale brown and, at the base, a short medial tongue of the same colour ; anteclypeus dark brown ; postclypeus bright greenish yellow with the lower border narrowly pale brown ; frons in front and above dark brownish black with the concavity of upper surface bearing a broad transverse reniform greenish yellow spot ; occiput tumid, greenish, darker at sides and above where it bears a close fringe of stiff short blackish brown hairs ; eyes pale golden brown behind.

Prothorax dark reddish brown, immaculate.

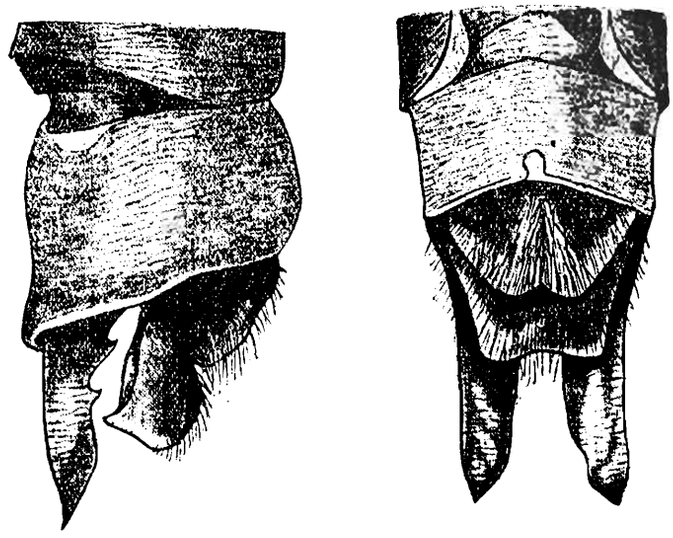
Thorax dark reddish brown with the following citron yellow markings,—a pair of wedge-shaped antehumeral stripes broad above where they are only separated by the middorsal carina, tapering to a point and diverging widely below ; two long narrow oblique stripes on each side, one on the anterior part of mesepimeron, the second on the middle of metepimeron ; a small upper spot between these two stripes and a large spot on anterior pairs of coxae. Thorax paler beneath.

Wings hyaline, faintly greenish in tint ; costa finely yellow to apex of wings ; membrane white ; pterostigma black, rather short, narrow, the hind longer than the fore, covering $2\frac{1}{2}$ to 4 cells ; nodal index, $\frac{12-18}{12-12}\Big|\frac{17-12}{12-11}$, $\frac{12-17}{12-11}\Big|\frac{17-11}{12-13}$; reticulation close ; anal triangle 3-celled, occasionally 5-celled ; discoidal cells 2-celled, occasionally 3-celled in the hind-wings ; all supratriangles entire ; only 1 cubital nervure to all wings ; 5 to 6 cells in the anal-loop, usually 6-celled.

Abdomen black marked with citron yellow as follows,—segment 1 brown with a small lateral spot near the ventral border ; segment 2 with an irregular subquadrate latero-basal

spot which includes the oreillets and bears a small rounded black spot at the extreme base of segment, a transverse saddle-shaped spot on the dorsum bordering the apical side of jugal suture and deeply concave behind, a pair of apical lunules and a large spot at the junction of apical and lateral borders, (in the specimen figured by Kennedy, *loc. cit.*, all these markings are confluent on the dorsum, thus enclosing a basal quadrate spot and a cordate subapical one) ; segment 3 with a pair of small apical lunules and a broad medial annule occupying the middle third of segment, notched behind on the middorsal carina and extending forward obliquely at the sides to reach the base of segment ; segment 4 similar but the annule occupying only slightly more than one-fifth the length of segment and the apical lunules very small ; segments 5 and 6 as for 4 but the apical lunules nearly obsolete on 5 and entirely so on 6 ; segment 7 somewhat similar to 6 but the annule relatively broader, occupying about one-fourth the length of segment and the lateral extension extending apicad as well as basad, so that the marking resembles the capital letter T as seen from above ; segment 8 entirely yellow save for a dorso-apical triangular spot of the ground colour and another broader one on the ventral surface ; segment 9 with a pair of basal lunules narrowly confluent over dorsum and occupying variably from nearly one-half to two-thirds the length of segment ; segment 10 with a pair of small basal dorsal spots. Legs black, femora dark reddish brown, armature as for genus.

Anal appendages black, superiors as long as segment 10. Seen from the side, sloping slightly down, upper border convex, lower somewhat sinuous and presenting a robust basal



TEXT-FIG. 19.—Anal appendages of *Cordulegaster diadema* Selys, ♂. From a specimen in the Williamson collection.

ventral spine and a smaller antemedian one which is hooked strongly back ; apices acute, bevelled strongly from below upwards. Inferior appendage slightly tapered to a squared apex which is very shallowly notched and bears some minute teeth above at each corner.

Segment 8 has a ventral projection in its apical half very evident in profile. Genitalia not differing in any marked respects from that of genotype.

Female.—Abdomen 60 mm. Hind-wing 50 mm.

Not differing from the male except in structural details and the markings of abdomen. Segment 1 immaculate ; segment 2 with a pair of small apical lunules and a narrow middorsal stripe, which on the sides runs obliquely forwards and downwards as far as base ;

segments 3 to 6 as for male ; segment 7 similar but without the latero-apical extension, (this extension is also absent in the male specimen figured by Kennedy) ; segment 8 with a broad subbasal band occupying nearly half the length of segment ; 9 with a narrow basal stripe, whilst segment 10 is unmarked.

Vulvar scale broad, shorter than in *dorsalis* and with the inner scales not extending as far as the apices of anal appendages, the latter appendages short, conical, pointed.

Distribution.—Mountains of Arizona and North Mexico. Orizaba and Cuernavaca in Mexico.

The specimens mentioned by Calvert, *loc. cit.*, have all a well marked medio-basal tongue of brown on the labium which extends about halfway towards the anterior margin. All except one, the specimen from Cuernavaca, have vestiges of a median stripe on the thorax. The abdominal annules may be interrupted on one or more of segments 6 to 9. The specimen from Ventanas has the occiput black fringed with white hairs, the labrum with a black border completely encircling it.

The anal appendages bear a strong resemblance to *bidentatus* but the species appears to be otherwise most closely allied to *maculatus*, *erroneus* and *godmani*. Wide variability is seen in the abdominal markings on segments 2 and the terminal which may indicate local races. Specimens are rare in collections, which may be due to actual rarity or a difficulty in obtaining the insect.

Cordulegaster obliqua obliqua (Say) (1839).

Aeschna obliqua, Say, *Journ. Acad. Phil.* VIII, p. 15 (1839).

Cordulegaster obliquus, Selys, *Bull. Acad. Belg.* (2) XLVI, pp. 692, 693 (1878) ; Needham, *Ent. News Phil.* XVI, p. 113 (1905) ; Kennedy, *Bull. Kans. Univ.* No. 1, pp. 136, 137, figs. 9-13 (1917).

Taeniogaster obliqua, Kirby, *Cat. Odon.* p. 81 (1890).

Coll. Serville 1 ♂ N. America (Rambur type),—coll. Paris Mus. 1 ♂ without locality ; coll. Williamson, 2 ♂ 1 ♀ Indianopolis, Indiana and Forest reserve, Clark Co., Indiana,—coll. Fraser, 1 ♂ N. America.

Male.—Abdomen 48-53 mm. Hind-wing 41-44 mm.

Head : labium brownish yellow ; labrum citron yellow finely bordered with pale brown at the concave part of anterior border and very finely with black at the extreme base, where a tiny median tongue of the same colour extends about halfway towards the anterior border ; anteclypeus blackish brown ; postclypeus pale olivaceous green ; frons citron yellow with a transverse band of blackish brown or olivaceous brown along the lower border of its front and a sinuous blackish or brown border at base above ; vertex black ; occiput olivaceous green, black at the sides and fringed with short stiff blackish brown hairs raised at the middle into a subacute prominent cone. Eyes meeting at a point ; behind eyes yellow narrowly bordered with brown above.

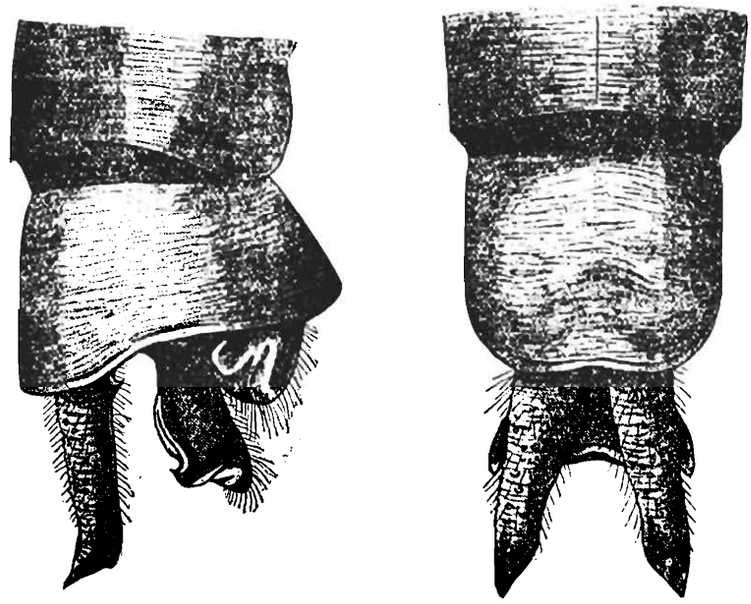
Prothorax and thorax dark reddish brown, the former with a narrow anterior collar, 2 middorsal linear spots and a small spot at each end of the posterior lobe citron yellow ; the latter with a pair of citron yellow antehumeral stripes diverging and tapering to a blunt point below ; laterally two oblique narrow stripes each bordered with black, one on the anterior part of mesepimeron, the second on the middle of metepimeron ; paler beneath.

Legs black, the two anterior pairs of femora dark brown, the hinder pair with a narrow longitudinal stripe of bright reddish brown on the outer side.

Wings hyaline, reticulation close ; costa bright yellow to beyond pterostigma, as also the antenodal nervures ; membrane black ; pterostigma blackish brown, slightly longer in hind-wing than fore, short, narrow, covering $2\frac{1}{2}$ to $4\frac{1}{2}$ cells ; anal triangle 3-celled ; all discoidal cells 2-celled ; nodal index,— $\frac{14-18}{12-13}\left|\frac{18-14}{13-14}\right.$, $\frac{11-17}{14-13}\left|\frac{19-13}{15-13}\right.$, $\frac{15-21}{15-16}\left|\frac{21-15}{15-16}\right.$; supratriangles entire or occasionally traversed once ; 2 cubital nervures in all wings, rarely only 1 in the fore-wing but quite occasionally only 1 in the hind ; anal loop very variable in shape, 3-6 celled.

Abdomen dark reddish brown or blackish brown marked with citron yellow as follows,— segment 1 with a small apico-lateral spot at the ventral border ; segment 2 with a large quadrate baso-lateral spot including the oreillet and confluent with the adjacent spot on segment 1, a large diffuse apico-lateral spot and a median dorsal stripe extending from base to apex, squared at base, tapering to a fine point at apex of segment and sending out a small prolongation on each side along the apical side of the jugal suture ; segments 3 to 7 with middorsal stripes extending from base nearly to apex and shaped like a spear-head with a short shaft, the latter being that part extending from the base of segments to the jugal suture ; the head of spear broader on segment 7 than on the preceding segments ; segment 8 with a large trefoil-shaped spot extending from base nearly to apex ; segment 9 with a small oval middorsal basal spot ; segment 10 immaculate.

Anal appendages black. Superiors apposed at base, diverging apicad, nearly as long as segment 10, subcylindrical, of even width, the apex bevelled outwardly and ending in an



TEXT-FIG. 20.—Anal appendages of *Cordulegaster obliqua obliqua* (Say) ♂. From a specimen in the Williamson collection.

acute slightly upturned point, the lower border sinuous and furnished with two spines, a robust basal followed almost immediately by a smaller antemedial one which is inclined slightly inwards. Inferior about two-thirds the length of superiors, notched at apex, subquadrate, the sides emarginate, the corners furnished with two or three small teeth above. Genitalia not differing appreciably from that of genotype.

Female.—Abdomen 55 mm. Hind-wing 48 mm.

A larger and more robust insect than the male, differing in a few points as follows : —Wings : pterostigma blackish brown, decidedly longer than in the male, covering $3\frac{1}{2}$ to 5 cells ; anal loop 6-celled ; nodal index,— $\frac{14-17}{14-15}\Big|\frac{18-15}{14-15}$; 2 cubital nervures in all wings, occasionally 1 in the hind ; all supratriangles traversed once ; all discoidal cells 2-celled.

Head : labium more broadly bordered with brown anteriorly, the black more evident at the base ; the whole front of frons dark olivaceous brown and the citron yellow sulcus above framed in brown ; occiput bright greenish yellow, larger and more conical and prolonged than in the male ; behind eyes brownish.

Abdominal markings exactly similar to the male, but segment 9, as well as 10, immaculate. Anal appendages conical, short, black ; vulvar scale very long, 7·5 mm. in length, projecting 3 mm. beyond end of abdomen, black, dark reddish brown at sides and base.

Distribution.—North America. Indianopolis and Forest Reserve, Clark Co., Indiana, May and June, Rock Island, Illinois, Andover, Massachusetts, Orono Maine and St. Hyacinthe, Canada. The type male described by Say is from Indiana and is said to have the legs black and a quadrate spot on dorsum of segment 10 but the latter is absent from all of Mr. Williamson's specimens from the same State.

[**Cordulegaster obliqua fasciatus** (Ramb. 1842).]

Cordulegaster fasciatus, Rambur, *Ins. Nevrop.* p. 178 (1842) ; Selys, *Bull. Acad. Belg.* (2) XLVI, p. 692 (1878).

Taeniogaster obliquus, Selys, *Bull. Acad. Belg.* (2) XXI, p. 108 (1854).

Cordulegaster obliquus, Selys, *Mon. Gomph.* p. 349 (1858) ; Hagen, *Neur. N. Amer.* pp. 116, 117 (1861).

Taeniogaster fasciata, Kirby, *Cat. Odon.* p. 81 (1890).

Coll. Br. Mus. 1 ♂ Georgia ;—coll. Hagen, 1 ♂ Georgia.

Male.—Abdomen 65 mm. Hind-wing 53-56 mm.

Both sexes very similar to those of *C. obliqua obliqua* and differing only in the following particulars :—

Size much larger, abdomen and hind-wing of male about 10 mm. longer, abdomen and hind-wing of female about 15 and 12 mm. longer respectively.

Male.—Abdomen 64-65 mm. Hind-wing 53-56 mm. Female.—Abdomen 69-72 mm. Hind-wing 59-60 mm.

Wings : nodal index higher,— $\frac{22-27}{21-21}\Big|\frac{27-20}{19-17}$; discoidal cells usually 3-celled and only occasionally 2-celled in one or more wings ; 2-3 cubital nervures in fore-wing, 2 in the hind ; supratriangles traversed once or twice in fore-wings, once in the hind ; anal loop 4-7 celled ; anal triangle 6-celled ; membrane white.

Head : labrum olivaceous, anterior border narrowly reddish brown, the sides and base finely black ; frons with a blackish brown transverse band on upper part of front and the base above narrowly brown ; occiput similarly shaped but the apical third of the cone black.

Abdomen and anal appendages similar to *obliqua*.

Distribution.—Confined, so far as known, to Georgia. Very closely related to *obliqua* and treated here as a mere subspecies of that insect although it may be a pure race. Differing

principally by its much larger size, by the higher nodal index, by the triangles 3-celled, the anal triangles more than 3-celled and by the white membrane.

The only specimen I have seen of this subspecies is the one mentioned by Selys in the Mon. Gomphinae, in the British Museum. In it the occipital cone is not black at the tip and its sides are brown. The basal spine of superior appendages is so near the base that it is altogether hidden and the small subbasal one is so close to the base that, at first sight, it appears to have taken the place of the basal one. The genitalia does not differ from the species.

[**Cordulegaster dorsalis** Hagen-Selys (1858).]

Cordulegaster dorsalis, Selys, *Mon. Gomph.* p. 347 (1858); *Id.*, *Bull. Acad. Belg.* (2) VII, p. 549 (1859); *Id.*, *ibid.* (2) XXXV, p. 772 (1873); Hagen, *Syn. Neurop. N. Amer.* p. 116 (1861); Kennedy, *Proc. U. S. Nat. Mus.* LII, pp. 515-523, figs. 138-143, 145, 146 and 147, A, (1917); Needham, *ibid.* pp. 696, 697 (1904); Cockerell, *Ent. News*, XXX, p. 32 (1919).

Male.—Abdomen 55 mm. Hind-wing 44 mm.

Head : labrum straw coloured ; labium citron yellow finely bordered with dark brown (no medio-basal tongue of black) ; anteclypeus dark brown ; postclypeus and frons citron yellow, the latter usually with a transverse, badly defined, brown stripe across its upper part just below crest and its extreme base above blackish brown ; occiput reddish brown, heavily fringed with stiff greyish brown hairs or golden in some and with two bright yellow spots behind.

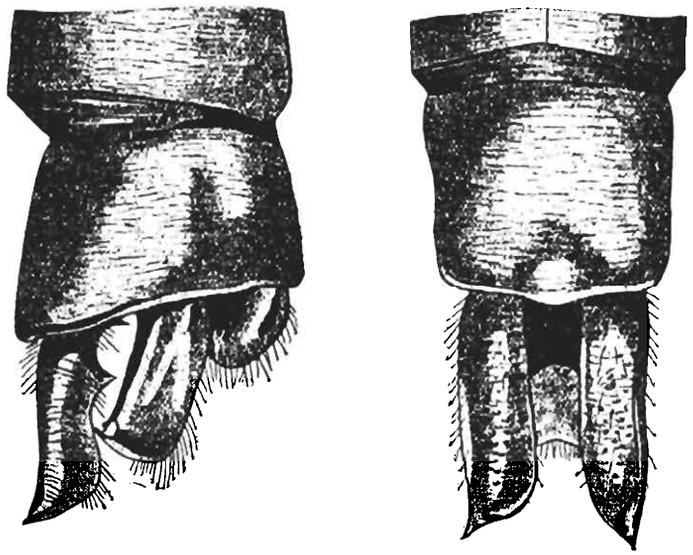
Thorax dark mahogany brown marked with bright citron yellow as follows,—two antehumeral cuneiform stripes expanding slightly below and bevelled inwardly ; two oblique moderately narrow lateral stripes which are not framed in black ; between these two stripes, at a little above the spiracle, a small citron yellow spot. Prothorax brown, immaculate. Legs dark reddish brown, tibiae and tarsi blackish brown.

Wings hyaline ; anal loop of 4 to 5 cells ; all discoidal cells 2-celled ; 1 cubital nervure in all wings ; all supratriangles entire ; anal triangle 3-celled but occasionally 4-celled ; membrane white ; nodal index,— $\frac{10-17}{11-13}\Big|\frac{16-8}{12-10}$, $\frac{10-17}{11-13}\Big|\frac{18-9}{12-11}$; pterostigma dark blackish brown, covering 2 to 3 cells, longer in the hind-wing than in the fore, narrow and short.

Abdomen black with median citron yellow spots,—segment 1 immaculate ; segment 2 with a baso-lateral spot on each side and a large variably-shaped spot on middorsum, notched slightly at the middle line both in front and behind and also on each side by the jugal suture, lastly two small apical lunules almost obsolete in some ; segment 3 with a large middorsal spot covering about its middle two-fourths ; segments 4 to 7 similar, but the spots narrower and slightly notched behind at the middle line ; segment 8 with a broad spot occupying its basal half ; 9 with a basal band occupying about its basal third, deeply notched subdorsally and in the middle line, so that it presents a series of apically directed points ; segment 10 variable, with a pair of small basal points and occasionally also an oblique narrow longitudinal line on each side.

Anal appendages black, very similar to those of *bidentatus*, bearing a robust ventro-basal spine easily visible in profile and a smaller midventral one ; the apex of appendage curved up and ending in a minute sharp spine. Neither spine visible from above. Inferior

appendage two-thirds the length of the superiors, which are equal in length to segment 10, notched at the apex and presenting a small spine at each upper corner.



TEXT-FIG. 21.—Anal appendages of *Corudlegaster dorsalis* Hagen, ♂. From a specimen in the Williamson collection.

Genitalia not differing perceptibly from the geno-type.

Female.—Abdomen 56 mm. Ovipositor 7 mm., overlapping the abdomen by about 4 mm. Hind-wing 47 mm.

Markings almost entirely similar to the male. The labrum rather broadly bordered with brown and with a pale medio-basal tongue of the same colour ; the spot on segment 2 larger and subtriangular, its apical border unnotched and parallel with the apical border of segment, lunules very small ; the middorsal spot on segment 8 bilobed, notched deeply behind and on either side ; segment 9 with a narrow basal stripe expanding broadly on the sides ; segment 10 immaculate.

Vulvar scale dark reddish brown tipped with black, the inner scales extending beyond the tips of anal appendages.

Wings hyaline or, in teneral specimens, enfumed and tinted with yellow especially along the costa, which is bright citron yellow to beyond the pterostigma, as in the male. Pterostigma light reddish or dark brown according to age of specimen ; loop 5-celled ; all discoidal cells 2-celled but occasionally entire ; all supratriangles entire ; only 1 cubital nervure to all wings ; nodal index similar to the male,— $\frac{10-16}{11-12}\left|\frac{14-9}{11-12}\right.$.

Distribution.—Kennedy in an interesting account of this insect, *loc. cit.*, gives the distribution as from the coast mountains of Sitka in Alaska southwards to the San Gabriel Mountains in Los Angeles, California. The type is a female, from Sitka, deposited in the Petrograd Museum. I have examined 3 males and a female all from California, collected by Dr. Kennedy who gives the following localities :—Found up to an altitude of 4,000 ft. on the western slopes of the Sierras in California but never recorded from the eastern side of those mountains. Stevens Creek, Santa Clara Co., California, May to August ; Zyante Creek, Santa Cruz Co., California, July ; Napa Asylum ground, Napa Co., California, June ; on the Arroyo Secco, Pasadena, California, June ; west slopes of Sierras, American river, Placer Co., and Bear Valley, Emigrant Gap, Placer Co., California.

Specimens of this insect appear to be rare in collections and it is not represented in the Selysian collection, nor do there appear to be any specimens in the European Museums. A specimen in the British Museum, determined by the late Mr. Kirby as *dorsalis*, is really *erroneus*. The bulk of the specimens in private and American State collections are those collected by Dr. Kennedy in California.

Its relationships to other species are by no means clear but I am inclined to link it with *erroneus* which it closely resembles. Selys was inclined to bracket it with *obliqua* on account of its spotted abdomen and the yellow behind the eyes, but the spots on *obliqua* are unique and totally different from those found on the abdomen of *dorsalis*, moreover the curious shape of the occiput in *obliqua* is not shared by the former.

Cordulegaster erroneus Selys (1878).

Cordulegaster erroneus, Selys, *Bull. Acad. Belg.* (2) XLVI, p. 688 (1878) ; Kirby,*Cat. Odon.* p. 81 (1890).

Coll. Selys 9 ♂, Nevada and Washington, California ; coll. Br. Mus. 1 ♂ (labelled *dorsalis* incorrectly) California,—Hagen, Kentucky and N. Carolina.

Male.—Abdomen 50-57 mm. Hind-wing 42-47 mm.

Head : Labium light reddish brown ; labrum citron yellow very finely bordered with blackish brown all round and with a medio-basal tongue of black ; anteclypeus blackish brown, the lower border paler ; postclypeus and frons citron yellow, the latter with a transverse stripe of blackish brown on its anterior surface just below crest as in *annulatus*, the base above narrowly reddish brown with a lateral prolongation forwards on each side ; vertex black ; occiput reddish brown, densely fringed with rather long stiff brownish hairs and with a small geminate spot of citron yellow behind ; behind eyes pale brownish yellow.

Prothorax dark reddish brown with a narrow yellow anterior collar and a small geminate spot of citron yellow on middorsum of midlobe.

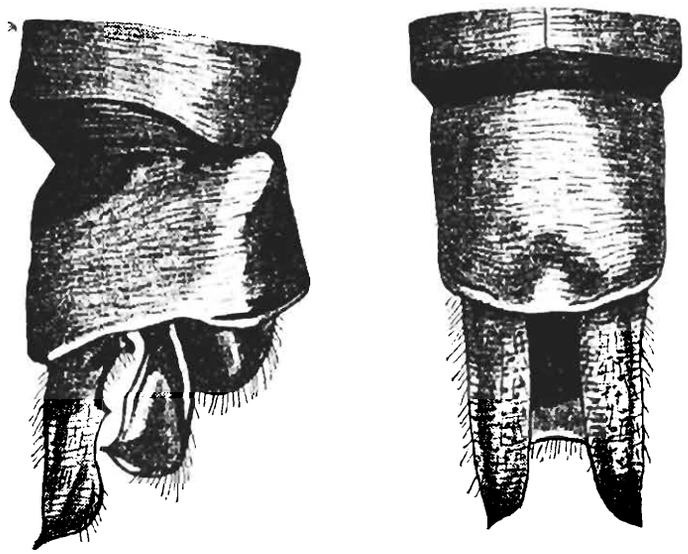
Thorax mahoghany brown marked with citron yellow as follows,—a pair of broad antehumeral stripes diverging below, not tapering as in other species of the genus but of even breadth throughout ; a pair of oblique moderately narrow lateral stripes, the first on the fore part of mesepimeron, the second on the middle part of metepimeron, finally a small upper spot between the two.

Legs black, femora dark reddish brown ; armature as for genus.

Wings hyaline, palely enfumed in adults, costa finely yellow ; reticulation close ; membrane narrow, white ; pterostigma dark reddish brown, short, narrow, that of hind-wing considerably longer than fore, covering $2\frac{1}{2}$ to 3 cells ; all discoidal cells 2-celled ; all supratriangles entire ; nodal index,— $\frac{9-15}{11-12}\Big|\frac{18-9}{13-12}$, $\frac{10-16}{11-11}\Big|\frac{16-10}{12-10}$, $\frac{10-17}{10-13}\Big|\frac{18-9}{10-11}$; anal loop 5-celled ; 1 cubital nervure in all wings ; anal triangle 3-celled.

Abdomen black marked with citron yellow as follows,—segment 1 reddish brown ; segment 2 with a spot on the oreillets, a saddle-shaped marking on the middorsum over the jugal suture, deeply notched behind, and a pair of small subapical lunules ; segments 3 to 7 with large middorsal spots slightly overlapping the jugal suture basad, deeply notched behind and sometimes actually divided into two spots on segment 6 ; a similar but very narrow subbasal spot on each side of segment 8, often confluent over middorsum ; segment

9 with a dorso-basal spot deeply notched in the middle and sides and occasionally subdivided into middorsal and lateral basal spots; segment 10 with an ochreous basal spot on each side. Segments 3 and 4 occasionally with small apical lunules; the middorsal spots considerably smaller than in *dorsalis*.



TEXT-FIG. 22.—Anal appendages of *Cordulegaster erroneus* Selys, ♂. From a specimen in the Selysian collection.

Anal appendages black; superiors nearly as long as segment 10, straight, parallel, apices rounded and ending in a small acute point in continuation of the outer border of appendage, a pair of robust ventral spines beneath, a basal, plainly visible in profile as in *bidentatus*, and a smaller median imbricated spine. Inferior appendage two-thirds the length of superiors, tapering slightly to apex which is shallowly notched and furnished with a minute tooth at each corner above.

Genitalia not differing markedly from the genotype.

Female.—Abdomen 64 mm. Hind-wing 51 mm.

Scarcely differing from the male except in sexual characters,—costa black or with but a vestige of yellow; abdominal markings a little broader except on end segments; annule on segment 8 nearly obsolete; abdomen much more robust and compressed; anal appendages short, pointed, conical, black; vulvar scale very long, about 8 mm., slender, black.

Distribution.—Carolina, north of Marganta, July-September; Kentucky, Bee-spring, June; Washington, and Nevada.

Related to *diadema* and *dorsalis*, especially to the last, of which it is possibly merely a local race. It differs by the labrum encircled with black and by the inferior anal appendage markedly tapered at the apex. The above description has been made anew from the specimens in the Selysian collection and differs in some respects from the original in which the pterostigma is described as black, the occiput yellow fringed with yellow hairs, the labrum traversed with black, the frons black, except the sulcus above, and lastly the back of eyes black. The original description is very brief and appears to have been made from a single specimen, although not one of the nine males in the Selysian collection agree entirely with it. All nine specimens have been determined by Selys as *erroneus*. Whilst *dorsalis* is confined to the western side of the Sierras in Californis, *erroneus* appears to represent it on the eastern side of the same mountains.

Cordulegaster sayi Selys (1854).

Cordulegaster sayi, Selys, *Bull. Acad. Belg.* XXI (2) p. 104 (1854) ; *Id., ibid.* (2) XXVIII, p. 203 (1869) ; *Id., ibid.* (2) XLVI, p. 686 (1878) ; *Id., Mon. Gomph.* p. 331 (1858) ; Hagen, *Neur. N. Amer.* p. 115 (1861) ; Kirby, *Cat. Odon.* p. 80 (1890) ; Hagen, *Syn. Odon. N. Amer.* (1875).

Coll. Br. Mus. 1 ♂ (the type), 1 ♂ N. America ; coll. Selys, 1♂ (labelled "*Thecaphora sayi*" and "*Cordulegaster sayi*," New Georgia.)

Male.—Abdomen 45 mm. Hind-wing 41 mm.

Head : Labium pale reddish brown ; labrum pale greenish, the anterior border narrowly reddish brown ; anteclypeus black ; postclypeus and frons pale greenish yellow, immaculate ; occiput greenish yellow framed in black and with a fringe of short stiff black hairs above ; eyes a little separated, green during life, markedly tumid behind, where the colouring is yellow bordered with glossy black above against the occiput—the latter lying deeply between the tumid eyes.

Prothorax and thorax blackish brown, the latter marked with greenish and citron yellow as follows,—a pair of broad antehumeral stripes on dorsum, divergent below, the middorsal carina between these ferruginous ; a pair of oblique moderately narrow stripes on each side, the first on mesepimeron, the second on the middle part of metepimeron. Between these two a third stripe, finer, ill-defined or interrupted.

Legs black, anterior pair of femora reddish brown, armature as for genus.

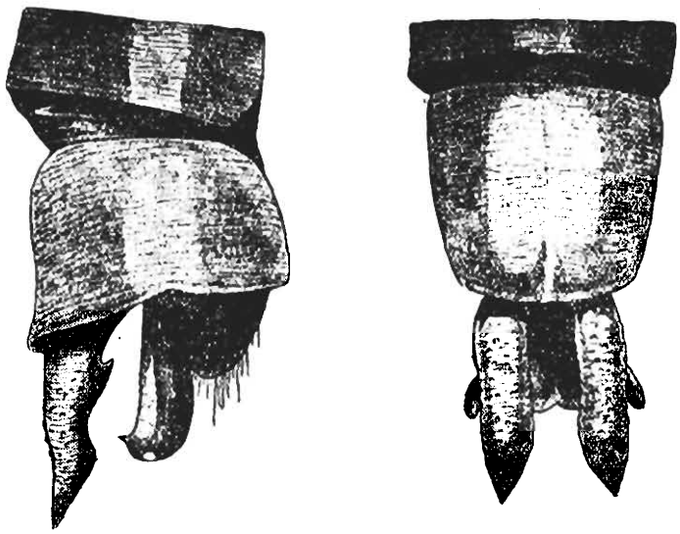
Wings hyaline, palely enfumed ; reticulation close ; membrane broad white ; pterostigma narrow, rather short, ferruginous, covering about 4 cells ; all discoidal cells 2-celled ; all supratriangles entire ; nodal index,— $\frac{11-18}{14-14}\left|\frac{19-12}{13-15}\right.$, $\frac{11-18}{14-12}\left|\frac{17-12}{12-15}\right.$; 2 cubital nervures in fore-wings, only 1 in the hind ; anal triangles 3-celled ; anal loop 3 to 4-celled.

Abdomen black marked with citron yellow as follows,—segment 1 tumid, pale brown ; segment 2 with a narrow dorsal antemedian stripe broken on the middorsal carina, a lateral stripe involving the oreillets, and a pair of moderately large apical lunules ; segments 3 to 6 with antemedial annules equal to about one-third the length of segments, extending obliquely forwards on the sides as far as base, indented apicad on the middorsal carina or occasionally interrupted, lastly a pair of apical lunules ; segment 7 with the dorsal annule nearly interrupted and situated nearer base of segment, apical lunules absent ; segment 8 similar but the annule subbasal and much broader ; segment 9 with a large angulated spot at the base on each side, extending apicad laterally as far as apical border and sometimes confluent over dorsum at base so as to enclose a large triangle of black with its base at apical border ; segment 10 with a pair of small basal subdorsal spots. (Markings of the two last segments subject to some variation and occasionally absent on segment 10).

Anal appendages black. Superiors about three-fourths the length of segment 10, parallel, straight, the apex pointed. Viewed in profile, a small antemedial spine on the ventral side sharply turned analward ; a second and more robust basal spine almost hidden beneath the overhanging 10th segment. Inferior appendage broader than long, the apex considerably broader than base but nearly quadrate and very slightly notched at apex, the sides curled up strongly, the corners prolonged and easily visible from above projecting from beneath superior appendages. Each corner has 2 or 3 small teeth on its upper surface ; the appendange about three-fourths the length of superiors.

Gentalia not differing markedly from the genotype.

Female.—Abdomen 48-52 mm. Hind-wing 40-42 mm.



TEXT-FIG. 23.—Anal appendages of *Cordulegaster sayi* Selys, ♂. From type in the British Museum.

Differs from male in but few respects, mainly sexual characters. The abdomen more robust, the yellow annules broader and not interrupted, no markings on segment 9, segment 10 yellowish with obscure black points on dorsum ; nodal index slightly higher ; anal loop 5 to 6-celled, anal triangle 5-celled. Ovipositor short, black, yellow at the sides, projecting but slightly from end of abdomen. Anal appendages very short, pointed, yellowish.

Distribution.—The White Mountains, New Hampshire, U. S. America, from June to August ; Georgia.

A rare species differing in several respects from all other Cordulegasters, except *diastatops*, by the slight separation of the eyes, the marked tumid condition of the back of the eyes, the green colour of the markings of head and thorax, the relatively short anal appendages of the male and the short ovipositor of the female.

Selys suggested that *sayi* might be included in his genus *Thecaphora* which he erected for *diastatops* ; the name *Thecaphora* was however pre-occupied, the genus being subsequently renamed *Zoraena* by Kirby. As the venation and genitalia of these two species does not differ in any respects from other Cordulegasters, it seems preferable to retain them in the same genus.

The type male in the British Museum has been repaired with the abdomen inverted, whilst the female in the Selysian collection is also in a bad condition, with the wings torn and segments 4 and 5 replaced with the wrong end forwards.

Cordulegaster diastatops (Selys 1854).

Thecaphora diastatops, Selys, *Bull. Acad. Belg.* (2) XXI, p. 101 (1854) ; *Id.*, *ibid.*, (2) XLVI, p. 685 (1878) ; *Id.*, *Mon. Gomph.* p. 320 (1858).

Cordulegaster lateralis, Scudder, *Proc. Boston Soc. Nat. Hist.*, X, p. 211 (1866) ; *Id.*, *ibid.*, XI, p. 300 (1867) ; Hagen, *Syn. Odon. Amer.* (1875).

Zoraena diastatops, Kirby, *Cat. Odon.* p. 79 (1890).

Coll. Br. Mus. 1 ♂ (in bad condition, the head missing, labelled in Selys' handwriting "*Thecaphora diastatops*" ; coll. Selys, 6 ♂ (one labelled "*C. diastatops*" ; one labelled

" Glenellis July 24," the others labelled " White Mountains" ; coll. Williamson, 2♂ 2 ♀, labelled, " Sandy Lake, Mercer Co. Pa. 7.x.04 " and " Mar. Buchanan, Mich. May, 29-14 ; coll. Fraser, one pair labelled " Manchester, Maine " ; coll. Morton, etc.

Male.—Abdomen 42-45 mm. Hindwing 36-39 mm.

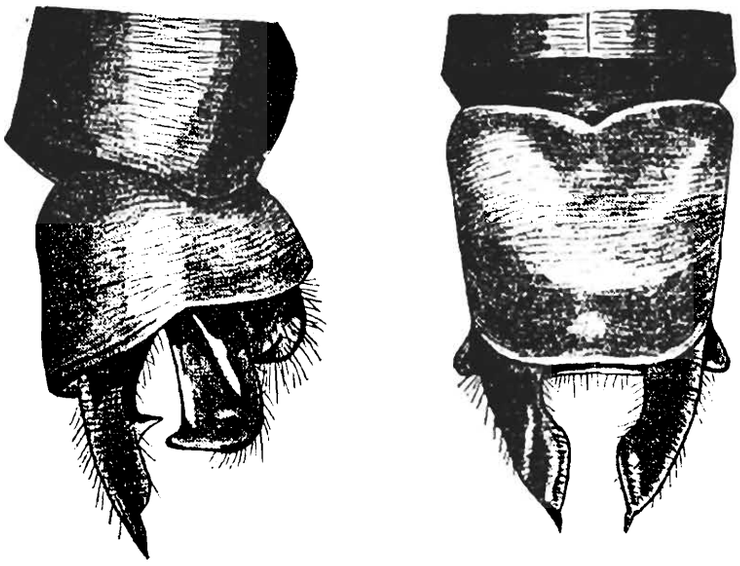
Head : Labium golden yellow ; labrum and bases of mandibles citron yellow with the anterior border pale brown ; anteclypeus brown or blackish brown ; postclypeus and frons pale greenish yellow ; occiput yellow in front and behind, fringed with short stiff dark brown hairs ; eyes slightly separated, golden yellow behind where they are markedly tumid.

Prothorax and thorax dark reddish brown, the former immaculate, the latter with a pair of wedge-shaped antehumeral greenish stripes diverging and pointed below, and a pair of oblique narrow citron yellow stripes on each side, one on the fore part of mesepimeron, the other occupying the central part of metepimeron.

Legs light reddish brown, the tarsi darker, or, in old specimens, black with the hinder pair of femora dark reddish brown, armature as for genus.

Wings hyaline, palely enfumed, deepening in adults especially towards the apices ; costa finely yellow ; reticulation close ; membrane cinereous or white ; pterostigma reddish brown, narrow, short, that of hind-wing slightly longer than the fore, covering $2\frac{1}{2}$ to $4\frac{1}{2}$ cells ; nodal index,— $\frac{11-16}{12-13}\left|\frac{19-13}{12-11}\right.$, $\frac{12-16}{12-13}\left|\frac{17-13}{12-12}\right.$, $\frac{15-17}{14-13}\left|\frac{16-14}{12-15}\right.$; anal triangle 3-celled ; anal loop 4 to 6-celled ; 2 cubital nervures in all wings in addition to that forming base of sub-trigone, or only 1 in the hind-wing ; all discoidal cells 2-celled ; all supratriangles entire, very rarely traversed in one or more wings.

Abdomen reddish brown, deepening to black towards the anal segments, marked with bright citron yellow as follows,—segment 1 immaculate ; segment 2 with the margins of genitalia and under surface of oreillets broadly yellow, and a pair of irregular broad subdorsal stripes extending from base to apex, enclosing on the middorsum a broad rectangular spot of the ground colour basad to the jugal suture and a hexagonal spot apicad to the suture ;



TEXT-FIG. 24.—Anal appendages of *Cordulegaster diastatops* Selys, ♂. From a specimen in the Selysian collection.

segment 3 with an irregular latero-dorsal stripe tapering apicad but broadening and becoming confluent with its fellow over the dorsum immediately apicad to the jugal suture ; segments

4 to 6 similar to 3 but the stripes not quite confluent over the dorsum ; segment 7 with a broad pyriform spot on each side of dorsum tapering apicad but not quite reaching apical border ; segment 8 with a similar but broader and shorter spot on each side ; segment 9 with a small subdorsal basal spot on each side ; segment 10 immaculate.

Anal appendages almost identical to those of *sayi* ; superiors blackish at base, reddish brown towards apices, parallel, straight as seen from above, with a broadly rounded lamina on the inner side just before apex, which is attenuated and pointed. Beneath, two robust spines, a basal which is quite hidden by the overhanging 10th segment and an antemedian smaller. Inferior appendage reddish brown or yellow, broader than long, the corners prolonged and projecting from beneath superiors and with two minute teeth above ; apex only shallowly notched. Genitalia as for genus.

Female.—Abdomen 47-49 mm. Hind-wing 41-42 mm.

More robust than the male, differs in a few particulars,—the yellow parts of the head and face bright citron yellow ; occiput citron yellow behind only at its centre, the sides blackish ; eyes even more tumid behind than in the male ; thoracic markings broader and, on the sides, framed in black ; a median stripe between the lateral stripes interrupted by the spiracle ; wings palely tinted with greenish along the costal margin ; 9 to 10 cells in the anal loop ; nodal index,— $\frac{18-18}{16-14} \Big| \frac{17-18}{12-17}$.

Abdominal markings more extensive, forming an almost continuous stripe along the sides ; segment 9 with a short transverse stripe at each side of the base ; segment 10 immaculate.

Anal appendages very short, conical, pointed, black ; vulvar scale very short as compared with other Cordulegasters except *sayi*, inner scales not extending as far as tips of anal appendages and the outer ones only slightly beyond them, blackish brown.

Distribution.—White Mountains, U. S. America ; Manchester, Maine. The exact distribution of this insect does not appear to have been worked out. Sandy Lake, Mercer, Co. Pa., and Buchanan, Michigan, are given as localities on two of Williamson's specimens, and the following note is written on one packet,—" A small stream, 1-2 ft. wide, flowing through a marsh meadow surrounded by hills and woodland. Stream arose in a skimp cabbage-alder spot at foot of hills. Only two Cordulegasters seen. They flew erratically along the stream near its source and frequently alighted on weed or twig-tips."

Closely allied to *sayi* by the shape of the eyes, anal appendages and ovipositor.

Genus **CHLOROGOMPHUS** Selys (1854).

Chlorogomphus, Selys, *Bull. Acad. Belg.* XXI, (2), p. 99 (1854); *Id.*, *ibid.*, (2) XLVI, p. 680 (1878) : *Id.*, *Mon. Gomph.* p. 311 (1857) ; Kirby, *Cat. Odon.* p. 78 (1890); Williamson, *Proc. U. S. Nat. Mus.* XXXIII, p. 277 (1907) ; Fraser, *Rec. Ind. Mus.* XXVI, p. 469 (1924); *Id.*, *ibid.*, XXVII, pp. 423-429 (1925); Ris, *Ent. Mitteil.* XVI, No. 2, pp. 103-105 (1927).

Orogomphus, Selys, *Bull. Acad. Belg.* (2), XLVI, p. 681 (1878) ; Kirby, *l.c.* p. 79 (1890); Williamson, *l.c.* p. 277 (1907) ; Ris, *Suppl. Ent. Deut. Ent. Mus.* No. 1, p. 77 (1912); Laidlaw, *Proc. Zool. Soc. London*, p. 58 (March, 1914) ; Fraser, *Journ. Bombay Nat. Hist. Soc.* XXIX, p. 44 (1923); *Id.*, *Rec. Ind. Mus.* XXVI, p. 469 (1924) ; *Id.*, *ibid.*, XXVII, pp. 423-429 (1925).

Head broad but not deep ; eyes nearly in contact or variably and moderately widely separated ; face very broad and shallow, postclypeus only slightly broader than frons, which

latter is rounded above, not excavate, raised, of the same height, or rather higher than occiput ; occiput small, tumid in the male, low and excavate in the female ; labium with mid-lobe cleft at its middle, much smaller than lateral lobes ; labrum with anterior border convex ; antennae with basal joint very short, the second three times as long, robust, slightly clubbed at distal end, third to sixth joints very slender, shorter, growing progressively shorter from the third to sixth.

Thorax relatively small, cubical ; legs robust but short, hind femora extending to apical end of segment 1, furnished, in the male, on flexor surfaces, with small numerous evenly-sized moderately closely-set spines, extending as two rows which converge and blend in a common field at proximal end of limb ; tibiae with moderately long robust numerous spines and furnished with a distal ventral keel on all limbs as in the *Macromia.* In the female similar but the rows of spines on femora discrete as far as proximal end of limb, more numerous and finer ; tibiae without keels ; claw-hooks robust, situated at middle of claws.

Wings very variable, long and broad especially the hind of females, which are, in some species, of enormous breadth at base, hyaline in all known males, hyaline, coloured for the greater part or partly opaque in the females ; apices often tipped with black in both sexes or in one sex only ; reticulation close or very close ; node situated much nearer pterostigma than base in the fore-wing ; pterostigma relatively short and narrow, rather longer in the female, rarely braced and then but poorly so ; membrane variable, usually short and narrow ; base of hind-wing shallowly excavate near the insertion of wing in the male, the excavation filled in by the membrane so that base is broadly rounded ; always rounded in the female ; discoidal cells variable in shape, with posterior angle acute or subacute, with basal side as long as or much longer than costal, traversed or reticulated, rarely entire, that of fore-wing commonly longer than hind ; supratriangles traversed ; subtriangles not well differentiated from rest of cubital space ; basal space traversed by 1 to 5 nervures ; cubital nervures numerous ; anal loop very variable, always well-formed and usually pentagonal, made up of 10 to 34 cells ; anal triangle 3-celled, short ; anal field variable, simple in the male and usually so in the female, but, in some species, made up of parallel columns of cells separated by supplementary sectors ; *Cuii* and *IA* separated by a single row of cells at origins in fore-wings, by 2 to 3 rows of cells in the hind ; *IA* usually forked but occasionally pectinate in the hind-wing ; *Riv+v* and *MA* sinuous at the distal ends ; supplementary nervures to the bridge present ; a basal incomplete antenodal nervure nearly always present in the sub-costal space of all wings ; *IRii* variable in origin, beginning nearer node than pterostigma or halfway between or even distad of inner end of pterostigma.

Abdomen variable, longer or slightly shorter than hind-wing especially in the female ; cylindrical in the male, slim, of even thickness except at base and anal end, the latter segments only very slightly broader than the medial. Laterally compressed in the female.

Anal appendages homogeneous, with some minor specific differences, slightly longer than segment 10, superiors widely separated, slightly curved and converging slightly at apices, often furnished with ventral spines ; inferior deeply cleft into slightly divaricate branches which are as long as superiors.

Genitalia very homogeneous, penis and lobe analagous to those of *Cordulegaster* but lamina and hamules differing widely. Lamina closed in, depressed as a plate presenting two low rounded bosses ; anterior hamules robust, sinuous, divergent, backwardly-directed

spines ; posterior hamules much finer, stilette-shaped organs directed backward and inward, their apices meeting ; lobe scrotal-shaped, the lip grooved and ridged.

Vulvar scale very inconspicuous, very short, notched at middle, with a small cylindrical appendage at the base of segment 9 which may correspond to the rudimentary gonapophysis seen in *Cordulegaster*.

Distribution.—From Western and North-east India, Burma, Java, Sumatra, Borneo, Indo-China, South China and the Philippines. Little has been recorded of the habits of the various species, but the author has studied *campioni*, *atkinsoni* and *speciosus* in their native haunts. Their habits, as illustrated by these species, differ markedly from those of *Cordulegaster ;* their flight on the level is comparatively weak, being not more fast than the speed of a fast running man ; they are, however, given to soaring and on occasions rise to hundreds of feet above the tree-tops of their native jungles, where, with the aid of field-glasses, they may be seen performing the most graceful evolutions not unlike the soaring, wheeling flight of vultures. Males have frequently been observed resting on twigs of dead or leafless trees some hundred or more feet above ground-level. At other times, both sexes are given to patrolling mountain roads, the glistening sunny surface of which, winding through jungles, they apparently mistake for rivers. In such situations they often descend and skim the surface, especially over dirty cattle standings, where they find abundant food. Pairing takes place far from the neighbourhood of water, the males probably never returning to their parent streams after emergence. No females have been observed ovipositing but one was seen to rise from the bed of a stream and had apparently been alighting for that purpose. They live and breed at high altitudes, certainly not under 3,000 ft. The larvae develop in fast running mountain streams, and contrary to the Cordulegasterine habit of lying-up under weed, burrow deeply in sand, generally at the foot of a small waterfall. (For details of larvae, see under species *atkinsoni* and *campioni*.)

The discovery of several species belonging to *Chlorogomphus* and *Orogomphus* since the Selysian classification was written, has demonstrated a merging of the characters of the two genera, so that it seems no longer desirable or practicable to separate them, indeed, save for the shape of the discoidal cell of the hindwing and, to a less extent, the length of the abdomen, it is impossible to differentiate strictly between the two genera. A third character given, *viz.*, that of the wider separation of the eyes in *Chlorogomphus*, falls to the ground, as the separation is even wider in *preciosus* which is otherwise an *Orogomphus sensustricto*, and it is at least as wide in other species of *Orogomphus*, especially in the females. Moreover the discoidal cells of the three known species of *Chlorogomphus* differ amongst themselves, being much narrower in *auratus* than *magnificus*, so that the width of the discoidal cells becomes merely a matter of degree passing insensibly from a very narrow to a broad triangle when a series is examined.

The classification adopted here is to retain and include all species under the genus *Chlorogomphus* for reasons already given above and in the preface of this work, dividing up the species into groups according to the shape of the discoidal cells, similar or dissimilar in fore and hindwings, narrow with acute posterior angle, or broad with subacute posterior angle, or broad with subacute posterior angle in the hindwing ; the length of abdomen and the colour of the wings in the female.

Group I. **MAGNIFICUS** (=**CHLOROGOMPHUS** Selys, *sens. strict.*)

Eyes moderately separated, especially in the female ; hindwing of female broad or very broad at base, both wings of same sex broadly saffronated and in part opaque ; discoidal cell of hindwing with posterior angle acute, basal side twice or nearly twice as long as the costal side, discoidal cells of fore and hindwings variable in shape ; abdomen of the same length as hingdwing or, in the female, slightly shorter. Group-type—*magnificus* Selys.

Group II. **CAMPIONI** (Links up groups I and II.)

Eyes moderately or widely separated in the female ; hindwing of female broad at base but less so than in group *magnificus*, both wings of same sex broadly saffronated, no opaque areas ; discoidal cell of hind-wing with posterior angle acute or subacute, basal side of same length or distinctly longer than costal, discoidal cells of fore and hindwing differing in shape in both sexes ; abdomen of the same length or slightly longer than hindwing. Group-type *campioni* Fraser.

Group III. **ATKINSONI** (=**OROGOMPHUS** Selys, *sens. strict.*)

Eyes almost meeting in both sexes ; hindwing of female not markedly broader than the male, which is moderately broad ; both wings of both sexes hyaline, uncoloured ; discoidal cell of hindwing subacute in both sexes, basal side of the same length or slightly shorter than costal ; discoidal cells of fore and hind-wings similar in the male, dissimilar in the female ; abdomen markedly longer than hindwing. Group-type *atkinsoni* Selys.

Key to species of *Chlorogomphus*.

1	Eyes moderately separated, especially in the female ; hind-wing of female very broad at base, and wings of same sex richly marked and tinted with golden brown or yellow ; discoidal cell of hind-wing with costal side much shorter than the two other sides and posterior angle very acute ; abdomen equal in length or shorter than the hind-wings	2.
	Eyes moderately or widely separated, especially in the female ; hind-wing of female broad at base but less so than in 2 ; wings of female broadly tinted with golden yellow but with no opaque areas as in 2 ; discoidal cell with costal and basal sides equal and posterior angle subacute ; abdomen equal in length or slightly longer than hind-wing	3.
	Eyes almost meeting in both sexes ; hind-wing of female not noticeably broadened ; wings of female not usually coloured ; discoidal cell with costal side slightly longer than basal and posterior angle sub-acute ; abdomen markedly longer than hind-wing	4.
2	Hind-wing of female with a broad angulated opaque band traversing it about the region of the node and base, and with the anal loop opaque yellow ; forewing without opaque areas	*C. magnificus* Selys.
	Fore- and hind-wings of female with broad angulated opaque bands about the region of the node and base	*C. papilio* Ris.
	Fore- and hind-wings of female without opaque areas but tinted with golden yellow throughout	*C. auratus* Martin.

3	Fore- and hind-wings of female evenly tinted with golden brown ; 3 to 4 median nervures in all wings ; anal loop with 22 cells ..	*C. xanthoptera* Fraser.	
	Fore- and hind-wings of female with costal borders and basal halves tinted with rich golden yellow ; 2 to 3 median nervures ; anal loop with only 16-17 cells	*C. campioni* Fraser.	
4	Thorax with only antehumeral and two lateral stripes ..	..	5.
	Thorax with antehumeral, humeral, posthumeral and 2 lateral stripes	.. ..	7.
5	Face dull pale brown without yellow markings	*C. atkinsoni* Selys.	
	Face black brightly marked with citron yellow	.. ..	6.
6	A basal incomplete antenodal nervure present in all wings ..	*C. dyak* Laidlaw.	
	No basal incomplete antenodal nervures present	*C. selysi* Fraser.	
7	Wings tipped with black at apices	*C. splendidus* Selys.	
	Wings not tipped with black at apices	.. ..	8.
8	A terminal yellow stripe on sides of thorax ; labrum entirely yellow ; only a single median nervure	*C. preciosus* Fraser.	
	No terminal yellow stripe on sides of thorax ; labrum black marked with two yellow spots ; 2 median nervures to all wings ..	*C. speciosus* Selys.	

Group I. **CHLOROGOMPHUS.**

Chlorogomphus magnificus Selys (1854).

Chlorogomphus magnificus Selys, *Bull. Acad. Belg.* XXI, (2), p. 99 (1854) ; *Id.*, *Mon. Gomph.* p. 313 (1858) ; Kirby, *Cat. Odon.* p. 78 (1890) ; Fraser, *Treubia*, VIII, 3-4, p. 484 (1926).
Chlorogomphus hyalinus, Selys, *Bull. Acad. Belg.* (2) XXXVI, p. 529 (1873).

Coll. Leyden Museum, 1 ♂ (type), 1 ♀, Java ; coll. Ris., 1 ♂, 1 ♀, Mt. Gedeh, Java ; coll. Br. Mus. 5 ♀, Sumatra and Java (Java, occident, Mons Gedeh, August 1892, H. Fruhstorfer, 4000 ft., and Sumatra, Benkoelen Dist., 1912-1919, C. J. Brooks) ; coll. Fraser 2 ♀ Sumatra.

Male.—Abdomen 46 mm. Hind-wing 45 mm.

Head : labium pale yellow ; labrum reddish brown broadly bordered with dark brown ; anteclypeus reddish brown ; postclypeus citron yellow ; rest of head dark ochreous or olivaceous brown with a narrow basal line of black on upper surface of frons and the hinder border of occiput narrowly ; eyes probably greenish during life.

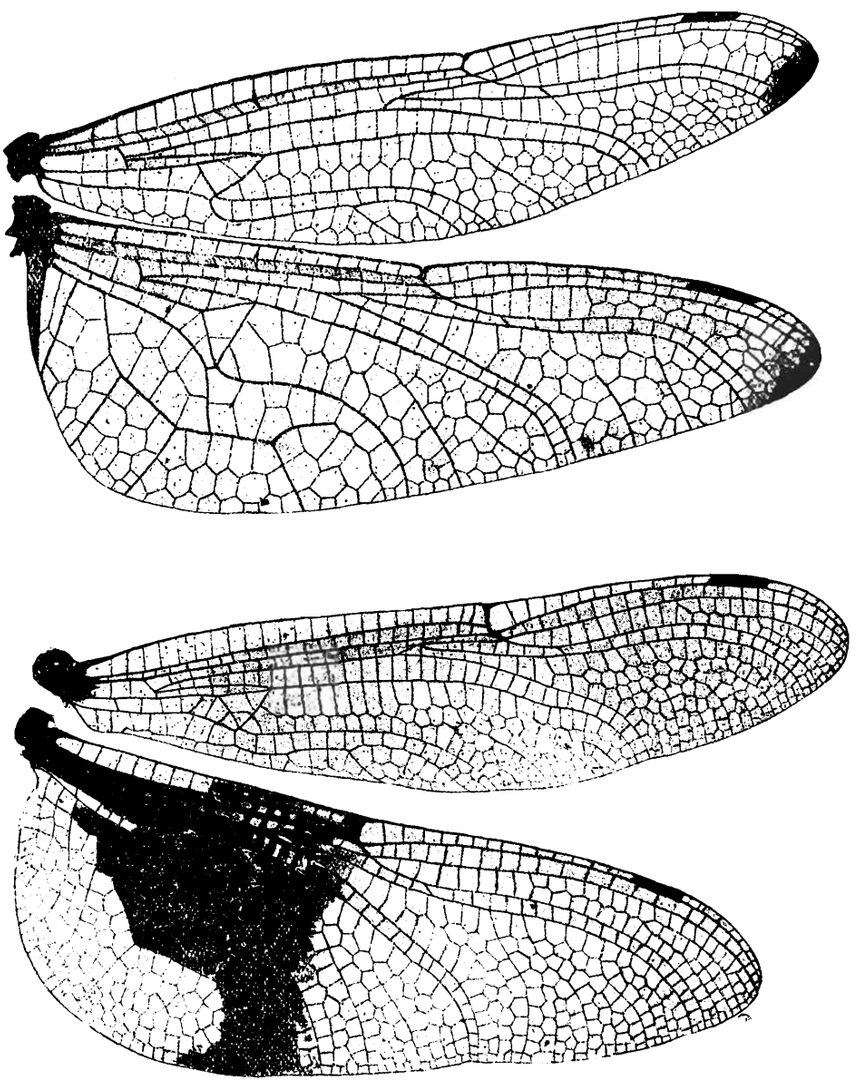
Prothorax dark olivaceous brown clouded with black.

Thorax olivaceous brown marked with citron yellow as follows,—a narrow straight antehumeral stripe, a still more narrow humeral stripe lying slightly anterior to the humeral suture and curving in slightly below towards the antehumeral stripe ; a broad oblique stripe on the sides which is continued on to dorsum of thorax between the wings, thus making a complete circuit of the thorax.

Legs short, black ; the femora yellow externally except at distal ends ; claw-hooks tipped with light reddish brown.

Wings hyaline except for the extreme apices which are tipped with blackish brown, this marking extending irregularly proximad to about halfway between apex and pterostigma in the fore-wings, but almost obsolete in the hind ; base of hind-wing rounded, only very

slightly excavate in its basal half, the excavation being filled in with the dark brown narrow membrane ; basal space traversed twice in all wings ; nodal index $\frac{10-21}{13-14} \Big| \frac{21-10}{14-12}$, the 2nd and the 9th antenodal nervures the primaries ; 5 to 6 cubital nervures in the forewings, 6 in the hind ; anal loop well formed as an elongate pentagon of 8 cells ; an incomplete basal nervure in the subcostal space of all wings ; anal triangle 3-celled of which 2 run parallel



B

TEXT-FIG. 25.—A. Wings of *Chlorogomphus magnificus* Selys, ♂. From the allotype in the Leyden Museum. (F. C. Fraser del.) B. The same of the ♀. (W. C. Davies photo.)

with the membrane and the 3rd forms apex of triangle ; discoidal cells traversed once in all wings or rarely entire in one of the fore-wings, discoidal cell of fore-wing with costal and distal sides equal, the basal about two-thirds their length, discoidal cell of hind-wing with its long axis transverse to wing, its distal and basal side subequal, the former slightly the longer, the costal side about two-thirds the length of basal ; supratriangles traversed 3-4 times in the fore-wings, twice in the hind ; 2 rows of discoidal cells in fore-wing to slightly distad of inner end of bridge ; *Cuii* and *IA* parallel in fore-wing, separated by a single row of cells ; *IA* forked before its outer end ; *Cuii* and *IA* widely separated by 1 to 2 rows of cells in the

hind-wing and *Cuii* forked as in the fore-wing ; *Riv+v* and *MA* a little sinuous especially in the fore-wings ; pterostigma black, over 2½ cells, short, unbraced.

Abdomen a little tumid at base, then triquetral and cylindrical, the 7th and 8th segments slightly broader than the adjacent ones ; black marked with citron yellow as follows,—the greater part of segment 1, a broad complete ring occupying the apical two-thirds of segment 2, a similar but more restricted ring on segment 3, which is nearly cut into two spots by an extension of the ground colour along the dorsal carina ; segments 4 to 7 yellow laterally, this colour confluent with a narrow apical ring occupying about one-sixth of the length of segments and incomplete on the dorsum, where the black carina cuts the rings into two spots ; segments 8 to 10 unmarked.

Anal appendages black, the superiors nearly as long as segment 10, subcylindrical, slender, widely separated from one another at base and then curving slightly towards one another and a little downwards, apices obtuse and coated with hairs below. Inferior appendage not unlike that of *Cordulegaster*, quadrate, nearly as long and broad as the separation of superiors at base, tapering slightly after the middle, the apex broadly and shallowly notched, coated with hairs below. Seen in profile rather thicker at base, curling up at the apex and with a small but robust tooth at each corner, hollowed out above, the sides raised.

Genitalia as for genus.

Female.—Abdomen 45-47 mm. Hind-wing 45-48 mm.

Head, thorax and abdomen coloured very similar to the male but the ground colour rather more reddish brown than black. Occiput depressed, hinder border undulate and fringed with long golden hairs.

Legs dark reddish brown, the anterior pair of femora paler.

Wings much broader than in the male, especially the hinder, broadly coloured and partly opaque, base of hind-wings rounded, very broad and closely reticulated into columns of cells ; fore-wings tinted bright amber from arc to apex, the extreme base, the costal space as far out as the distal primary antenodal nervure and a broad poorly defined area at the middle and posterior part of wing uncoloured ; hind-wing with a broad angulated dark brown fascia extending from the base of wing in the subcostal and basal spaces outwards to the distal primary antenodal nervure at which level it expands abruptly to the costal margin and as far out as the node, whilst a little beyond the level of the same antenodal it extends backwards as far as the hinder border of wing, angulating abruptly and expanding slightly along the border of wing. The proximal border of this marking presents three rounded indentations, the distal is sinuous, the costal part of it has the cell middles clear amber, whilst in the angle between its two limbs lies a large, opaque, light ochreous area comprising the outer third of the cubital space, the anal loop and a few cells (2 or 3) to its inner side, the discoidal cell, the inner end of the discoidal field and of the space included between *Cuii* and *IA*. Bordering the dark brown fascia, and nearly the whole of the wing distad to it, is bright golden amber ; pterostigma dark reddish brown, covering 3 cells, unbraced ; discoidal cells similar to male but that of fore-wings 3-celled, by nervures which run perpendicularly from sides of triangle and converge at its middle ; that of hind 2 to 3-celled, nervures running from distal to basal sides ; membrane short, white ; anal loop similar in shape to male but with 11-13 cells ; 8 to 9 cubital nervures, the proximal one more robust than the others and evidently the true anal crossing ; 3 basal nervures in fore-wings, 2 in the hind ;

2 rows of discoidal cells in fore-wing to well proximal of inner end of bridge ; *IA* as for male ; nodal index $\frac{12-24}{18-17}\Big|\frac{25-14}{18-18}$; $\frac{12-26}{15-17}\Big|\frac{27-11}{17-14}$; *Cuii* and *IA* separated by 2 rows of cells at their origins ; 2 rows of postanal cells in fore-wing, 10-11 in the hind.

Abdomen markedly compressed ; vulvar scale broad, slightly emarginate, tumid, very short. Yellow annules on abdomen broader than in male.

Anal appendages short, about half the length of segment 10, conical, pointed, brown.

Distribution.—Java and Sumatra. The type and paratypes in the Leyden Museum are from Sumatra, the male unfortunately in a very dilapidated state. Although Selys first associated the male and female as the sexes of a single species, he altered his opinion later, describing the male as a new species under the name of *hyalinus*. A comparison of the two with the two sexes of *campioni* will however convince one that his first conjecture was the correct one as the difference between the two sexes of *magnificus* is not much greater than that between those of *campioni*, moreover the thoracic markings are entirely similar.

Chlorogomphus papilio Ris (1927).

Chlorogomphus papilio, Ris, *Ent. Mitteil.* XVI, No. 2, pp. 103-105 (1927).

A single female, coll. Ris, from the Province of Kwang-Tung, Liedping, South China. Male unknown.

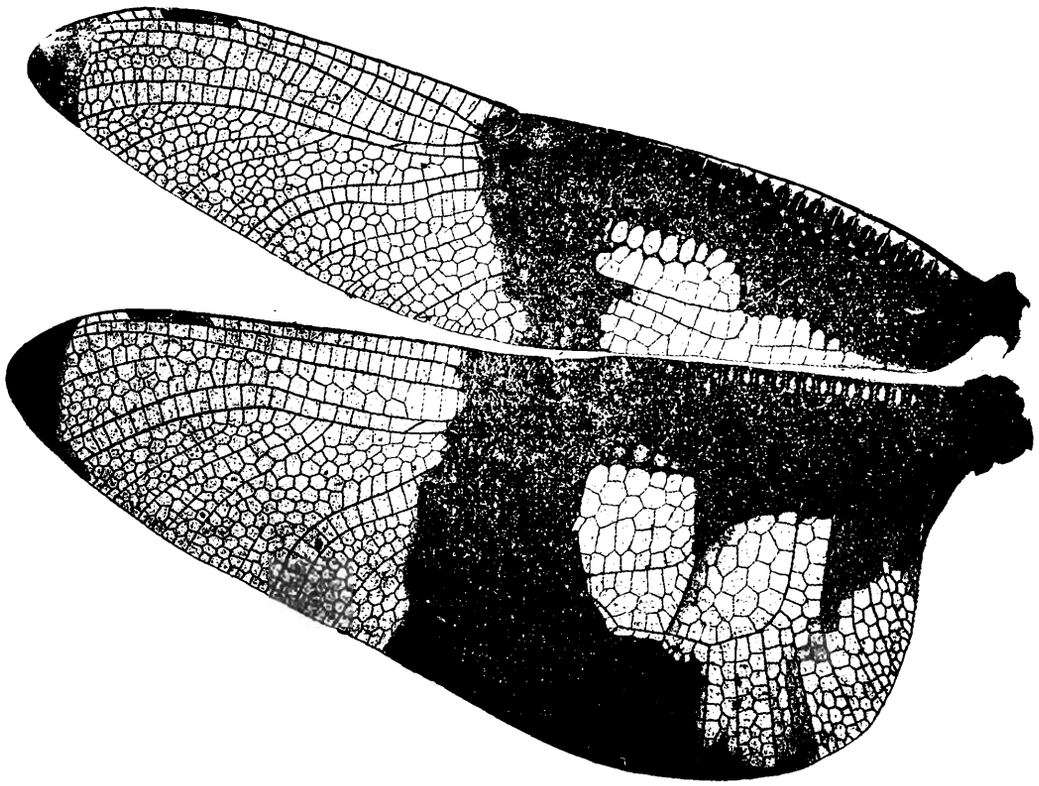
Female.—Abdomen 59 mm. Hind-wing 70 mm. (31 mm. broad.)

Head : labium dark reddish brown, small, fringed with long hairs ; labrum, anteclypeus and base of mandibles black ; postclypeus dull reddish brown (possibly yellow in the living state), the lateral ventral angle clouded with black ; frons black with a dull reddish brown stripe (perhaps yellow when living) along the crest, moderately broad on the dorsum, narrow on the front of frons ; vertex, occiput and hinder border of head and antennae black. Vesicle small, not obscuring the ocelli ; occipital plate hollowed out into a broad sulcus at its middle. Eyes green (during life), separated by less than 1 mm.

Thorax relatively very small, black striped with dull reddish brown (possibly yellow in the living state), a narrow mesepisternal stripe and a somewhat broader metepimeral one. Beneath thorax, and the legs, black, the latter short, not furnished with any special spines, claw-hooks robust, situated slightly distad of the middle of claws.

Wings very broad, partly hyaline, partly opaque. The hyaline part tinted with a rich enfumed yellow and marked with a deep blackish fascia with rather paler cell-middles. On the fore-wing this marking extends up to the node and passes from thence rather obliquely back proximad as far as termen. The discoidal field for about 8 cells in length and the field between *IA* and the termen for about 4 cells wider proximad hyaline, so that the black extends as a broad costal band overlapping the discoidal cell, whole base of wing and expanding distad as a complete transverse band. In the hind-wing, this marking also present, extending to 4 cells distad of node, very broad outwardly and extending nearly up to tornus. In the hindwing the part immediately proximad of the distal band is a light sulphur yellow in which the reticution remains dark coloured. The apices of all wings are blackish brown, this marking sharply limited at 3 cells distad of pterostigma. The latter black, 5 to 6 mm. in length ; discoidal cells in fore-wings 4-celled, 4 to 5-celled in the hind ; 2 median nervures to all wings ; 9 to 10 cubital nervures in the fore-wings, 8 to 9 in the hind ; nodal index—

$\frac{18-30}{22-20}\Big|\frac{29-17}{22-18}$; supratriangles traversed 6 times in the fore-wings, 4 in the hind; bridge traversed 7 to 8 times, the oblique nervure lying far distad; anal loop very large, 35 cells,



TEXT-FIG. 26.—Wings of *Chlorogomphus papilio* Ris, ♀. From a photo of the type in the Ris collection.

about 5 cells long in longitudinal axis of wing, by 7 cells in the transverse; numerous supplementary nervures in the anal area of hind-wing; 1 row of cells between *Cuii* and *IA* at their origin in the fore-wings, 3 to 4 rows in the hind, then continued as 2 rows of cells as far as termen.

Abdomen markedly compressed, black marked obscurely with yellow but too indistinct to make out in type, from post-mortem decomposition.

Anal appendages small, conical, pointed, two-thirds the length of supraanal tubercle which is a large arched cone. Vulvar scale at end of 8th ventral plate, small, blunt, triangular; the 9th ventral plate not visible, probably flat and straight; 10th ventral plate somewhat spine-shaped but not projecting posteriorwards.

Distribution.—Confined to South China so far as known. Type in Dr. Ris' collection. The male is probably very similar to that of *magnificus*, which the female closely resembles, being distinguished by its much greater size, the black apices of the wings and the extension of the opaque markings on to the fore-wing. Taking its wing expanse with its robustness of body, it is about the largest known dragonfly.

Chlorogomphus auratus Mart. (1910).

Chlorogomphus auratus, Martin, *Bull. Soc. Ent. France*, p. 65 (1910).

Coll. Martin, 1 ♀, (Paris Mus. type) Tonkin.

Female.—(Male unknown). Abdomen 54 mm. Hind-wing 52 mm.

Head: labium yellow; labrum black; anteclypeus yellow, post clypeus and frons black, the latter with its crest yellow; frons above, and rest of dorsum of head, black.

Prothorax black with a middorsal spot of yellow.

Thorax black marked with citron yellow as follows,—slender oblique antehumeral stripes, divergent below, converging above and nearly meeting towards the antealar sinus; slender humeral stripes and a broad oblique stripe on each side.

Legs black. Abdomen compressed, black marked with yellow as follows,—segment 1 with the sides broadly and a small yellow middorsal spot; segment 2 similar but the dorsal spot prolonged into a dorsal stripe pointed apicad; segment 3 with the basal half yellow, the black invading it slightly along the dorsal carina; segment 4 similar but the yellow occupying the basal third only; on segments 5 to 7 the yellow reduced to paired basal dorsal spots which are a little confluent on latter segment; segments 8 to 10 unmarked. Segment 8 rather broader than the adjoining segments.

Anal appendages short, conical, widely separated, shorter than segment 10 and separated by a conical process which projects beyond them.

Wings broad, saffronated throughout, apices broadly dark brown, bases dark but paler along border of membrane; triangle of fore-wings 3-celled, that of the hind 5-celled; 3 rows of discoidal cells in fore-wings; pterostigma black, slender, covers 4 cells; membrane mediocre, pale brown; hypertrigones traversed 5 to 6 times; 28 antenodal nervures in fore-wings, of which the 1st and the 10th are the primaries, 18 postnodals. (The subcosta prolonged beyond the node in both fore-wings and left hind-wing of the type as in *Phenes*, but this may be an aberration, as this character has not been noticed in any other species of the genus.)

Distribution.—Tonkin. The type, the only known specimen, is in the Paris Museum. The male will probably be found to be very similar to that of *magnificus* or *campioni*. If the prolonging of the subcosta beyond the node is a constant character in this species, it should be sufficient to separate it from any other, but the females of *campioni* and *freda* closely resemble it.

Chlorogomphus xanthoptera (Fraser 1919).

Orogomphus xanthoptera, Fraser, *Journ. Bombay Nat. Hist. Soc.* XXVI, No. 3, pp. 874, 875 (1919); *Id.*, *Rec. Ind. Mus.* XXVI, p. 469 (1924).

A single ♀, the type, from the High Range, South India, now in the Br. Mus.

Female.—Abdomen 54 mm. Hindwing 56 mm.

Head: eyes emerald green; labium, labrum, bases of mandibles, clypeus and frons yellow, the latter with the diffuse brownish black line at its base above; occiput and vertex black, the former fringed with coarse yellow hairs.

Prothorax brownish, unmarked.

Thorax brownish black marked with yellow as follows,—a short antehumeral stripe running parallel with the upper part of the middorsal carina and confluent above with a long narrow humeral stripe, thus forming an inverted loop; two broad lateral stripes on each side, the anterior running from the root of fore-wing, the latter lying on the posterior part of metepimeron. Beneath thorax brown.

Legs black, unmarked, short but robust.

Wings hyaline but deeply and evenly tinted with rich amber throughout the whole of their extent, although there is some mottling due to many cells being hyaline at the centre ; pterostigma black, short not braced, covering about 3 to 4 cells ; median space traversed 4 times in the fore-wings, 3 in the hind ; 9 cubital nervures in fore-wing, 8 in the hind ; nodal index—$\frac{13-24}{16-18}\Big|\frac{25-12}{19-16}$; supratriangles traversed 4 to 5 times ; 22 cells in anal loop which is nearly quadrate.

Abdomen black marked with bright yellow as follows,—segment 1 with a subtriangular spot on dorsum and its sides broadly ; segment 2 with a pair of small apical dorsal lunules, a broad basal dorsal transverse stripe and the sides broadly ; segment 3 with a pair of apical and a pair of middorsal lunules and its sides at the base ; segments 4 to 7 with dorsal and apical lunules only, remaining segments unmarked. Segments 1 and 2 dilated dorso-ventrally, 3 to 6 narrow and cylindrical, 7 broadening apicad, 8 and 9 dilated and depressed and finally tapering to segment 10 which is very short and narrow.

Anal appendages short, conical, black, pointed. Vulvar scale broad, short, slightly overlapping onto segment 9.

Distribution.—Travancore so far as at present known. The type was taken by Mr. Prater in the High Range. He was resting in the jungle when the insect alighted on his *topee* which he had taken off and laid by his side. Apparently the insect was attracted by the glare of the tropical sun on the white helmet very much as a moth is attracted to the light of a lamp. The male, which is unknown, is almost certainly closely similar to that of *C. campioni* Fraser.

The late Mr. H. Campion was inclined to regard this species more as a *Chlorogomphus* than an *Orogomphus* but suggested that it was probably a connecting link between the two Selysian subgenera. He noted that the eyes were more separated than in true *Orogomphus*, the triangle of the hind-wing was more narrow, as in *Chlorogomphus*, and the length of the abdomen in relation to that of the hind-wing was more in accord with *Chlorogomphus*. *C. xanthoptera* is conspicuously larger than *C. campioni*, the wings are uniformly tinted instead of patchily so as in *C. campioni* and the terminal segments of the abdomen are much more dilated and depressed.

Chlorogomphus campioni (Fraser 1924).

Orogomphus campioni, Fraser, *Rec. Ind. Mus.* XXVI, pp. 467-469, (1924).

Coll. Br. Mus. 1 ♂, (type), 1 ♀, (co-type) ; coll. Fraser 3 ♂, 3 ♀, Coorg, 1 ♂, Malabar ; coll. Williamson, 1 ♂, 1 ♀, Coorg ; coll. Laidlaw, 1 ♂, 1 ♀, Coorg ; coll. Morton, 1 ♂, 1 ♀, Coorg.

Male.—Abdomen 53 mm. Hind-wing 45 mm.

Head : labium pale yellow ; labrum black ; ante- and post-clypeus black, the latter traversed by a citron yellow stripe which broadens at either end ; frons black, its crest in front and above and a spot on either side citron yellow, frons as high as occiput which is black and fringed with coarse hairs ; eyes moderately separated, brilliant emerald green ; margins of face and frons fringed with coarse black hairs.

Prothorax black with a large yellow spot on each side.

Thorax black marked with bright citron yellow as follows,—a narrow oblique ante-humeral stripe, its upper end turning slightly out and nearly confluent with the upper end of

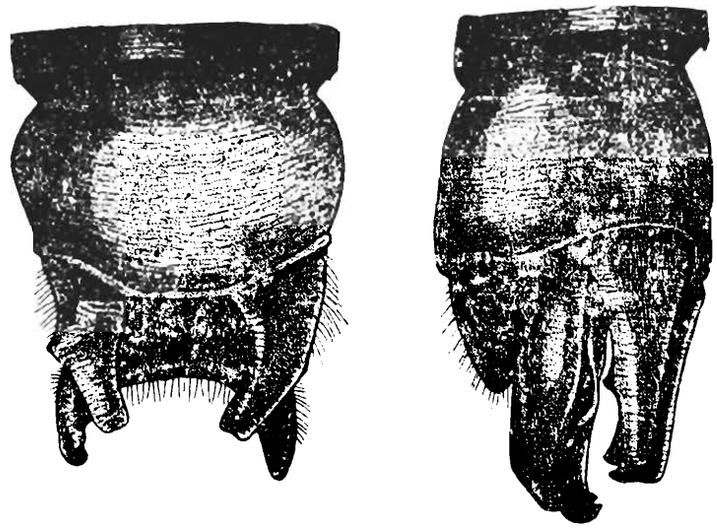
a humeral stripe, its lower end tapering to a point but not extending as far as the anterior border of thorax ; a humeral stripe slightly constricted above, broadening below, where it becomes confluent with a spot on the coxae ; a post-humeral superior spot placed well behind the upper end of humeral stripe ; a broad stripe lying obliquely across the middle of each side of thorax ; lastly the hinder half of the metepimeron ; beneath black.

Legs black, coxae, trochanters and a stripe on the outer side of the anterior pair of femora yellow. A row of very closely-set minute spines on the femora and a single longer distal spine.

Wings hyaline, the extreme apices dark brown ; pterostigma black, narrow, long, covering 3 cells, unbraced ; a basal incomplete ante-nodal nervure present in all wings ; 2 median nervures in all wings ; nodal index—$\frac{12-22}{13-15}\Big|\frac{22-11}{16-13}$, $\frac{12-21}{15-17}\Big|\frac{21-11}{17-13}$; 7 cubital nervures in the fore-wings, 6 in the hind ; discoidal cells traversed in all wings by a single strongly curved nervure which runs from the costal to outer side of cell ; supratriangles traversed 3 times in all wings ; membrane brown ; greatest breadth of hind-wing 15 mm.

Abdomen black marked with yellow as follows,—segment 1 with a small dorsal spot and the sides broadly ; segment 2 with a complete apical ring, a pair of dorsal lunules separated only by the middorsal carina and placed on the apical side of jugal suture, the sides, basad to the jugal suture broadly, and to the apical side, narrowly yellow ; segment 3 similar but the apical ring almost divided by the middorsal carina ; segments 4 to 7 with narrow paired apico-dorsal lunules, segment 4 having a vestige of the jugal pair of lunules ; remaining segments black, unmarked.

Anal appendages black, superiors as long as segment 10, curling slightly inwards, apices squared, faintly notched and bearing a minute downwardly directed tooth, base very thick



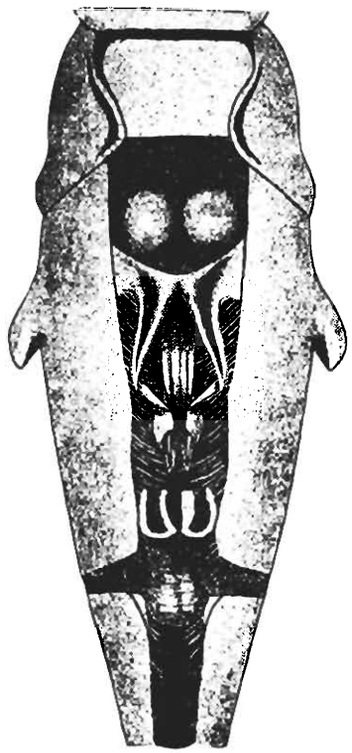
TEXT-FIG. 27.—Anal appendages of *Chlorogomphus campioni* (Fraser) ♂.

as seen from above and in profile, tapering rather rapidly thereafter and presenting a moderately robust midventral tooth, which inclines somewhat outward, so that it is usually visible from above ; inferior appendage very deeply and very broadly notched, its branches widely divaricate, their ends curling up and ending in a minute bifid tooth or pair of spines.

Genitalia.—Lamina very depressed, shallowly notched at its middle, emarginate and with a small spine on each side ; inner and outer hamules very similar, foliate, broad at

base and tapering to a fine inwardly curled spine, the inner hamules more slim and more sinuous ; lobe vesiculated, shaped like the bowl of a pipe with a short stem.

Female.—Abdomen 52-55 mm. Hind-wing 50 mm.

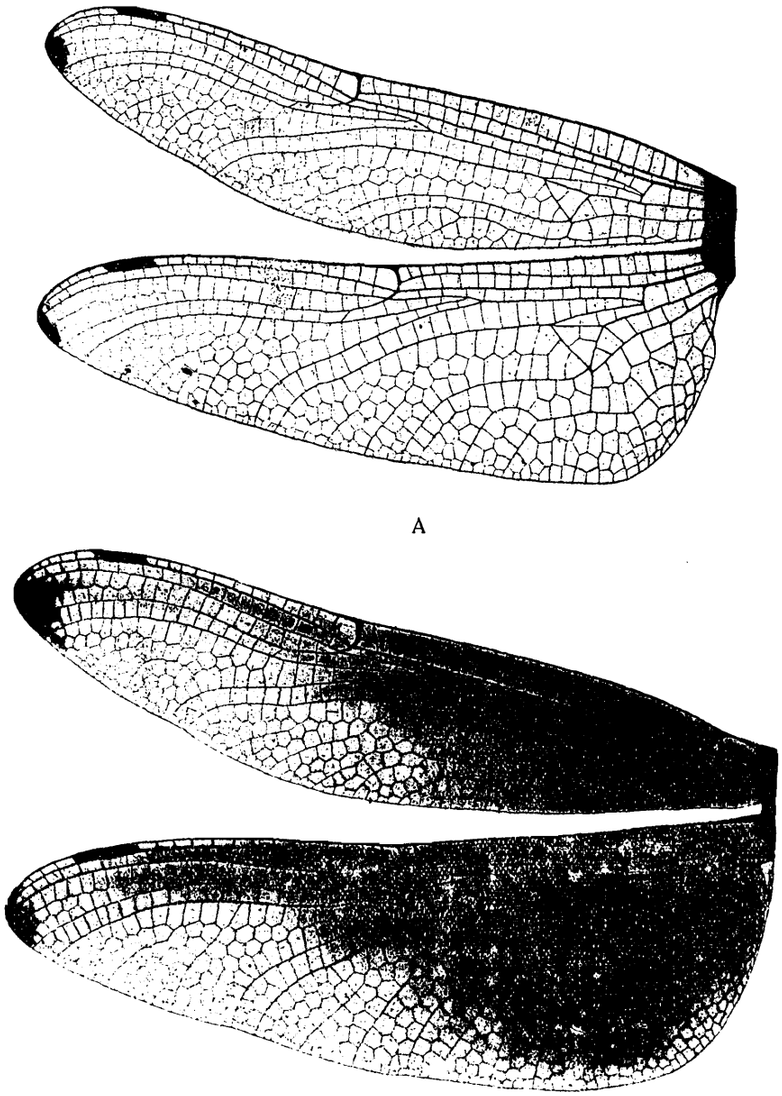


TEXT-FIG. 28.—Genitalia of *Chlorogomphus campioni* (Fraser) ♂.

Colour and markings of body very similar to the male but the markings of abdomen more restricted, especially on segments 3 to 7 ; segment 8 with a small apico-lateral spot on each side and a yellow U-shaped spot beneath at its base ; abdomen slightly tumid at base, laterally compressed, slightly narrowed from segment 4 to 6, slightly dilated from 7 to 8, abruptly narrowed and rather elongate thereafter.

Wings hyaline, apices diffusely tipped with blackish brown, almost the entire surface of wings tinted with rich golden brown but this very variable, in fully adult specimens the tinting is pale and limited to the costal halves of wings, but extending towards the posterior borders at level of discoidal cell, especially in the fore-wing ; in one old specimen, however, the tinting is deep golden amber and extends over the whole surface of wings, being only slightly paler towards the middle of the hinder border of wings, the reticulation also is rather heavily outlined in dark enfumed brown ; in other specimens the tint is deep and fairly uniform in the fore-wing, similar in the hind, but entirely absent throughout the whole of the hinder border ; 2 rows of cells between the origins of *Cuii* and *IA* ; 3 to 4 cells in discoidal cell of fore-wings, 4 to 5 in the hind, which is distinctly narrowed and with the distal side longer than the costal or basal (in the male the discoidal cells of fore- and hind-wings are similar in shape, the costal and distal sides being equal and considerably longer than the basal ; in the female, the discoidal cell of fore-wing is very similar in shape but broader than in the male, whereas the cell in the hind-wing is quite differently shaped, the basal and distal sides being subequal and both considerably longer than the costal. It is to be noted, however, that the

shape of this cell in the hind-wing is subject to considerable variation and is occasionally equilateral) ; pterostigma black, covering about 2 to $2\frac{1}{2}$ cells ; supratriangles traversed 4 to



A

B

TEXT-FIG. 29.—A. Wings of *Chlorogomphus campioni* (Fraser) ♂. From the type in British Museum collection. B. The same of the ♀. (E. Herring photo.)

6 times, usually only 4 times ; nodal index $\frac{11-23}{14-16}\Big|\frac{22-13}{16-14}$, $\frac{14-23}{15-19}\Big|\frac{24-13}{19-15}$; 8 to 10 cubital nervures in all wings ; loop with 16 to 17 cells ; 2 to 3 median nervures in all wings, usually 3. Greatest breadth of hind-wing 17 to 18 mm.

Head broader than in the male and the eyes much more widely separated.

Anal appendages very small, conical, pointed, black ; vulvar scale almost absent, a mere ventro-apical projection of the under border of segment 8, barely visible in profile.

Distribution.—Confined to the Western Ghats of India from South Kanara to North Malabar at altitudes of from 2,000 to 4,000 ft. during the months of April and May. The larva breeds in montane streams near their source and is to be found buried deep in the sand at the foot of small waterfalls. It resembles the larva of *Cordulegaster* closely and is

almost identical to that of *C. atkinsoni.* The perfect insect is given to soaring to great altitudes or hawking along mountain roads and looks very like a *Macromia* in flight for which it is often mistaken.

Larva.—Length of male 33 mm., of female 35 mm. ; hind femur 24-26 mm. Body colouring ochreous, but the face and mask are blackish brown and the dorsum of thorax and head rust red, to agree with the reddish sand which forms its environment. Head subquadrate, wider than deep, eyes projecting prominently ; frons projecting as a thin broad lamina ; mask cupped, pyriform in outline, two series of 7 setae on each side of the cup of body of mask, sloping inwards and forwards ; lateral lobes trilobate, each lobe deeply serrate at borders and all broadly confluent to form the combined lobe, the edges of which are coarsely spined and bear 5 long setae on the inner surface and a long movable hook at apex ; middle lobe deeply cleft at its border, the edges of the cleft curling out, and the borders of the lobe minutely toothed (the whole mask closely similar to that of *Cordulegaster*).

Thorax robust, as broad as head, abdomen torpedo-shaped, fusiform, subcylindrical in section, each segment coarsely haired at sides.

Wing cases extending to base of 4th segment, widely divaricate ; legs short, very hairy ; vulvar scale very minute, present as two very minute conical protrusions on hinder border of 8th segment.

Gizzard with four folds as in *Cordulegaster*, the teeth smaller, with blunt rounded apices and three rounded dentations on each side ; each of the anterior teeth with 3 robust teeth at the base, thus differing markedly from *atkinsoni,* wherein the whole surface of the anterior teeth are covered with spines, but none at base.

Chlorogomphus speciosus (Selys 1891).

Orogomphus speciosus, Selys, *Odonate de Birmanie, Ann. Mus. Civ. Genov.* (2) X, pp. 481-482 (1891) ; Laidlaw, *Rec. Ind. Mus.* XI, p. 197 (1917).

Female.—Abdomen 57 mm. Hind-wing 46 mm.

Head : labium and bases of mandibles yellow ; labrum glossy black marked with two short oval yellow spots at centre ; ante- and post-clypeus yellow ; frons black in front and above, the crest narrowly yellow ; vertex black ; occiput yellow fringed with black hairs ; eyes emerald green, rather widely separated.

Prothorax black marked with yellow.

Thorax black marked with citron yellow as follows,—a narrow ante-humeral stripe with its upper end curving outward and nearly confluent with a broader humeral stripe which curves in above ; a fine post-humeral stripe, a broad medio-lateral stripe and a slightly narrower stripe on the anterior half of metepimeron. Beneath yellow with two longitudinal obscure lines.

Wings hyaline, uncoloured ; pterostigma black, short, covering $2\frac{1}{2}$ to 3 cells ; 2 median nervures to all wings ; 7 to 8 cubital nervures to all wings ; nodal index—$\frac{13-23}{17-17}\Big|\frac{23-13}{17-19}$; 4 traversing nervures to all supratriangles ; an incomplete basal ante-nodal nervure in all wings ; discoidal cell in fore-wing 2-celled, in the hind 3-celled, similar in shape to that of *C. preciosus* ; membrane black.

Abdomen black marked with citron yellow as follows,—segment 1 with a dorsal spot and the sides broadly ; segment 2 with a pair of post-jugal transversely elongate spots separated by the black dorsal carina, a broad lateral spot and a moderately broad apical annule ; segment 3 with its base at the sides, a pair of fine lunules bordering the jugal suture and a pair of apical lunules confluent over the dorsum ; segments 4 to 7 similar but without the post-jugal spots and 7 with the apical marking much broader ; segment 8 with a minute yellow spot at its ventral apical corner ; beneath ventral sutures yellow. Segments 1 and 2 tumid and again from 7 to 9, cylindrical in between these.

Anal appendages black, short, conical ; vulvar scale as in *C. preciosus.*

Legs black, unmarked save for the anterior femora which are yellow at the base within.

Distribution.—The type, formerly in the Selysian collection, was unfortunately lost in the sinking of the P. & O. Egypt, and there is no other specimen known. It was taken at Taho, Burma, in March. From the Selysian description it is evidently very closely allied to *preciosus* from which it differs by not having the terminal yellow band to the metepimeron, by having the labrum black marked with 2 yellow spots instead of all yellow and by the wings not bearing any vestige of golden yellow tinting. There are also 2 median nervures instead of only 1 as in *preciosus,* a constant character in most species. The greatest breadth of the hind-wing is 15 mm. as in *preciosus,* against 17 mm. in *splendidus* which falls into the same group. From *splendidus* it differs by the uncoloured wings, by the labrum spotted with yellow instead of all black and by not having the apices of wings tipped with dark brown.

Chlorogomphus preciosus (Fraser 1924).

Orogomphus preciosus, Fraser, *Mem. Dept. Agric. Ind.* VIII, No. 8, pp. 75, 76 (1924).
Orogomphus speciosus, Laidlaw (*nec* Selys), *Rec. Ind. Mus.* XI, p. 198 (1915).

Coll. Br. Mus. 1 ♀ (type) ; coll. Fraser 4 ♂ 2 ♀ all from Sikkim and Darjeeling District, 4,000 ft., May.

Male.—Abdomen 59 mm. Hind-wing 42 mm.

Head : labium ochreous ; labrum greenish yellow, its outer borders diffusely brown, its base narrowly black and with a median brownish furrow extending about halfway to anterior border ; ante-clypeus yellow clouded with brown laterally, post-clypeus bright greenish yellow with a small oval spot of brown on either side of the median line ; frons black in front and broadly so at base above, the crest bright greenish yellow ; vertex and occiput black, the latter very obscurely yellow at its centre and fringed with black hairs ; eyes narrowly separated, bright emerald green during life.

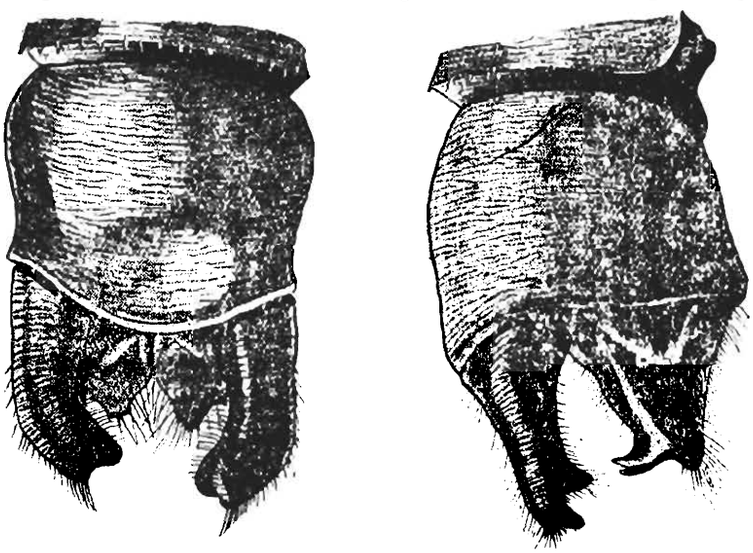
Prothorax black, the posterior lobe and a spot on each side bright citron yellow.

Thorax black marked with citron yellow as follows,—a narrow oblique ante-humeral stripe expanding above and turning slightly outwards to nearly meet a narrow humeral stripe which is markedly constricted at its middle ; a very narrow post-humeral stripe expanding slightly below ; a median broad lateral stripe separated narrowly from an equally broad stripe which covers the anterior half of metepimeron, and lastly the hinder half of the metepimeron very narrowly. Beneath yellow with a basal spot and two sinuous black stripes.

Legs rather short, black, the coxae, trochanters and extreme base of anterior femora bright yellow.

Wings hyaline, uncoloured; pterostigma black, moderately short, covering about $2\frac{1}{2}$ cells; a single median nervure to all wings; 5 to 7 cubital nervures to all wings; an incomplete basal ante-nodal nervure to all wings; discoidal cells similar in fore- and hind-wings, costal and distal sides equal and longer than basal, 2-celled in all wings; nodal index—$\frac{11-23}{14-16}\left|\frac{21-12}{18-15}\right.$, $\frac{12-20}{14-18}\left|\frac{20-12}{16-15}\right.$; anal loop 8-celled; 3 to 4 transverse nervures to supratriangles; only a single row of cells between the origins of *Cuii* and *IA* in hind-wings; anal triangle 3-celled; membrane blackish brown.

Abdomen black marked with citron yellow as follows,—segment 1 with a dorsal spot and the sides broadly; segment 2 with a pair of middorsal lunules finely separated by the middorsal carina but confluent outwardly with a large lateral spot which includes the smallish oreillet, extends along the ventral borders of segment and turns up along the apical border



TEXT-FIG. 30.—Anal appendages of *Chlorogomphus preciosus* (Fraser) ♂. From a specimen in the Fraser collection.

to become confluent with a pair of apical lunules which are themselves confluent across dorsum; segment 3 with the extreme base at sides yellow, a pair of post-jugal dorsal narrow lunules, and a pair of larger apical lunules which are broadly confluent over dorsum; segments 4 to 7 with similar apical lunules, but that on segment 7 double the width of the others, remaining segments unmarked.

Anal appendages black. Superiors as long as segment 10, curved towards each other in their apical halves, broad at base, bifid at apex, the robust ventral spine situated near the apex and not visible from above, a tuft of coarse hairs springing from the outer aspect of the blunt apex; inferior appendage equal in length or slightly longer than superiors, broadly and deeply bifid, the two sides of the cleft curled strongly upwards and ending in a short bifid spine. Seen in profile the lower edge of the cleft projects beyond the apices and is coated with coarse hairs.

Genitalia very similar to that of *campioni*, the lobe smaller and yellowish.

Female.—Abdomen 55 mm. Hind-wing 44 mm.

Closely similar to the male in colour and markings, differs as follows,—the labrum with less brown and black markings, the midio-basal furrow not usually evident; ante- and post-clypeus unmarked with brown; frons reddish brown in front and its base above dark reddish brown; occiput nearly entirely yellow, its outer ends black, fringed with coarse yellow hairs

except at the extremities where the hairs are black as in the male ; yellow markings of thorax broader, the ante-humeral and humeral stripes usually confluent above at a point.

Wings hyaline tinted with golden yellow rather variably, usually the bases only as far out as the distal ends of discoidal cells but quite occasionally the colour is deeper and much more extensive. In a specimen from Kurseong the wings are a rich golden amber tint from base to level of node and thereafter along costal margin as far as apex, where it again expands over the whole apex from the level of proximal end of pterostigma, the area including the discoidal cell and its immediate neighbourhood is rather more palely tinted than the rest of wing ; pterostigma black, narrow, moderately long, covering 3 cells and occasionally braced ; discoidal cell in fore-wing 2 to 3-celled, its costal and distal sides equal and much longer than the base, the same cell in the hind-wing 3-celled, subequilateral, the base slightly shorter than the costal side and the latter slightly shorter than the distal ; anal loop with 10 to 12 cells ; 2 rows of cells between the origins of *Cuii* and *IA* ; remaining venational details similar to the male ; greatest breadth of hind-wing 15 mm. ; nodal index $-\frac{12-20}{13-17}\Big|\frac{18-11}{17-16}$; $\frac{12-23}{15-20}\Big|\frac{26-12}{21-16}$.

Anal appendages very small, conical, pointed, black. Vulvar scale quite inconspicuous and invisible in profile, a mere overlapping of the apical end of 8th segment with no definite processes.

Distribution.—Type in the Pusa collection, since transferred to the British Museum, a female from Mungpoo, Sikkim, 4,000 ft., taken in May 1922. I found it in the same locality in May and June 1927, and possess a female from Kurseong. It probably occurs throughout the Darjeeling district, Sikkim and probably Nepal. Its flight resembles that of *campioni*, soaring in character but quite occasionally hawking at low levels over grassy places on hill-sides. Closely related to *speciosus* and *splendidus*, and is distinguished from the former by its single median nervure and the yellow labrum, and the female by its coloured wings ; from *splendidus* by its labrum yellow instead of entirely black, and by a single median nervure instead of 3 in all wings.

Chlorogomphus splendidus (Selys 1878).

Orogomphus splendidus, Selys, *Bull. Acad. Belg.* (2), XLVI, p. 681 (1878) ; *Id.*, *Ann. Soc. Esp. Hist. Nat.* XI (p. 16 sep.) (1882) ; Martin, *Mission Pavie* (p. 14 sep.) (1904) ; Laidlaw, *Proc. Zool. Soc. London*, pl. i, fig. 8 (1914) ; Ris, *Suppl. Ent.* No. 1, pp. 77-79, fig. 15a and 15b, pl. iii, figs. 1 and 6 and pl. v, fig. 5 (1912) ; Laidlaw, *Rec. Ind. Mus.* XI, p. 197 (1915) ; Kirby, *Cat. Odon.* p. 79 (1890).

Coll. Paris Mus., 1 ♀ (type), Luzon, Philippines ; coll. Ris, 1 ♂ Kosempo, Formosa, 1-5, VII, 1908 (co-type) ; *Id.* 1 ♂ Hoozan, Formosa, V, 1910 ; Mus. Munchen, 1 ♂ Kosempo, Formosa, 1-5, VII, 1908 ; coll. Sarawak Mus. 1 ♀ Borneo ; coll. Laidlaw, 1 ♀ Borneo ; coll. Martin, 1 ♀ Tonkin.

Male.—Abdomen 55 mm. Hind-wing 47 mm.

Head : labium reddish brown ; labrum black, unmarked with yellow ; ante-clypeus black, post-clypeus yellow with a minute dark point on each side of the middle line and the lateral borders brownish ; frons black in front and broadly at base above, the crest citron yellow ; vertex and occiput black, fringed with black hairs ; eyes probably green during life.

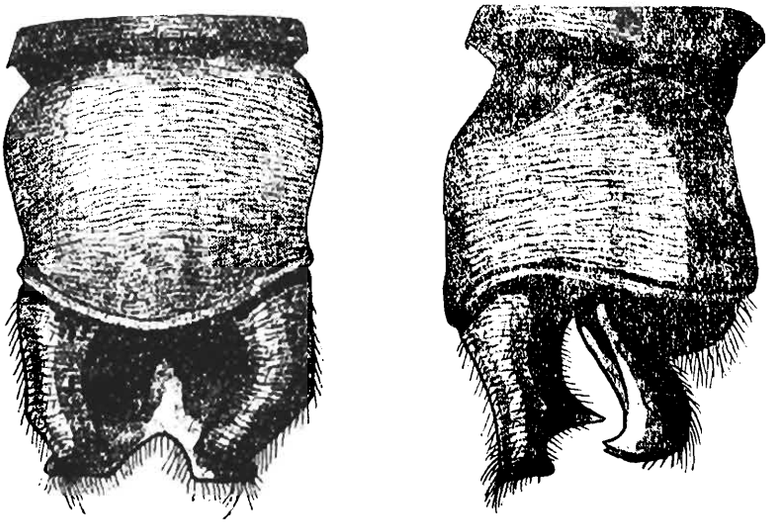
Prothorax black, unmarked.

Thorax black marked with bright citron yellow as follows,—a narrow very oblique antehumeral stripe slightly dilated in its upper part, which lies near the alar sinus; broader, slightly sinuous humeral stripes dilated below, a very broad medio-lateral oblique stripe on each side and a second on the hinder border of metepimeron.

Legs black, the anterior femora yellow on the inner side at the extreme base.

Wings hyaline tinted diffusely with pale yellow and with a deeper yellow patch at the anal angle; pterostigma moderately short, narrow, black; costa finely yellow; membrane blackish; 7 to 8 cubital nervures in all wings, rarely 9; usually 2 median nervures to all wings, but not uncommonly 3; 4 to 6 transverse nervures to supratriangles; nodal index—$\frac{20-32}{24-24}\left|\frac{33-18}{26-23}\right.$, $\frac{17-27}{19-20}\left|\frac{27-17}{20-19}\right.$, $\frac{20-27}{23-22}\left|\frac{30-19}{21-22}\right.$; discoidal cells with 3 to 4 cells, that of fore-wing with costal and distal sides equal and considerably longer than the base, that of hind-wing with basal and distal sides subequal and considerably longer than the costal side, the posterior angle thus being very acute as in typical *Chlorogomphus* in the Selysian sense; anal triangle 3-celled; anal loop with about 18 to 20 cells; 2 rows of cells between the origins of *Cuii* and *IA* in the hind-wing; apices of wings tipped with black.

Abdomen black marked with yellow as follows,—segment 1 with two lateral spots and a transverse stripe at the apical border; segment 2 with a broad basal lateral spot broadening over the oreillets, two small, transversely elongate post-jugal dorsal spots and a narrow interrupted apical ring confluent with a latero-apical spot; segment 3 with the ventral border broadly yellow at the base, finely thereafter, a pair of small post-jugal dorsal spots and a pair of apical lunules; segments 4 to 6 with only apical lunules which become progressively smaller as traced back; segment 7 with a broader apical ring occupying one-fifth of the length of segment dorsally, nearly one half at the sides; remaining segments unmarked; segments 1 and 2 dilated, 3 to 6 cylindrical and contracted, 7 and 8 widening considerably, 9 and 10 again narrowing and short.



TEXT-FIG. 31.—Anal appendages of *Chlorogomphus splendidus* (Selys) ♂. (F. C. Fraser del. after Ris.)

Anal appendages black. Superiors barely as long as segment 10, broad at base, especially in profile view, apex blunt, squared, a very robust ventral spine situated at about the outer third of appendage and showing as a slight angulation outwards as viewed from above;

inferior appendage rather narrowly but deeply cleft, the lateral branches curving upward and ending in two minute teeth.

Genitalia black, closely resembling that of *C. campioni.*

Female.—Abdomen 58 mm. Hind-wing 49 mm.

Colour and markings as for the male ; legs black, external surface of femora yellowish ; wings hyaline tinted with enfumed yellow at base and along costal margin, the colour fading as traced towards the pterostigma but intensifying and spreading towards the central parts of wings at node and discoidal cell, apices of all wings blackish brown from the pterostigma which is black, shorter than in the male and covering about 3 cells ; 6 to 7 cubital nervures ; 3 median nervures to all wings ; 5 to 6 transverse nervures to supratriangles ; nodal index of fore-wings,—14-23 25-14 ; discoidal cell 3-celled in all wings ; membrane black.

Anal appendages slender, short, conical ; vulvar scale broad and very short, rudimentary.

Distribution.—The type is a female from the Philippines, the male cotype from Formosa. Laidlaw has also described two females from Borneo. The habitual extremely local distribution of all other species of the genus leads one to suspect that the male described by Dr. Ris, as given above, is not the true male of *splendidus*, and the much closer reticulation of the wings in his male, as compared to the type female, lends support to this view, for as a rule we find a much richer venation in the latter sex. Laidlaw's females from Borneo conform more to type and a comparison of these wings with the male described by Dr. Ris clearly brings out the much closer reticulation in the latter ; these two females have the apices of wings unmarked thus differing from type, there is however some tinting of the membrane in this area as compared to the black tips of the males. In the type description by Selys, no mention is made as to whether there is any incomplete basal antenodal nervure present ; this is absent in Dr. Laidlaw's specimens, but present in all wings of Dr. Ris' males. I think the probability is that we are dealing with three distinct species, to determine which point more material is necessary.

Chlorogomphus selysi, sp. nov.

Coll. Fraser, 2 ♂, Mungpoo, Sikkim, 3,600 ft. (One the type.)

Male.—Abdomen 54 mm. Hind-wing 38 mm.

Head.—Labium bright yellow ; labrum black with a greenish yellow, crown-shaped marking at its centre ; anteclypeus yellow, its outer ends brown ; postclypeus and lower half of frons bright greenish yellow ; upper half of frons black, its crest, which is higher than occiput, narrowly citron yellow, its base above broadly blackish brown ; occiput black heavily fringed with dark brown hairs ; eyes almost meeting, brilliant emerald green.

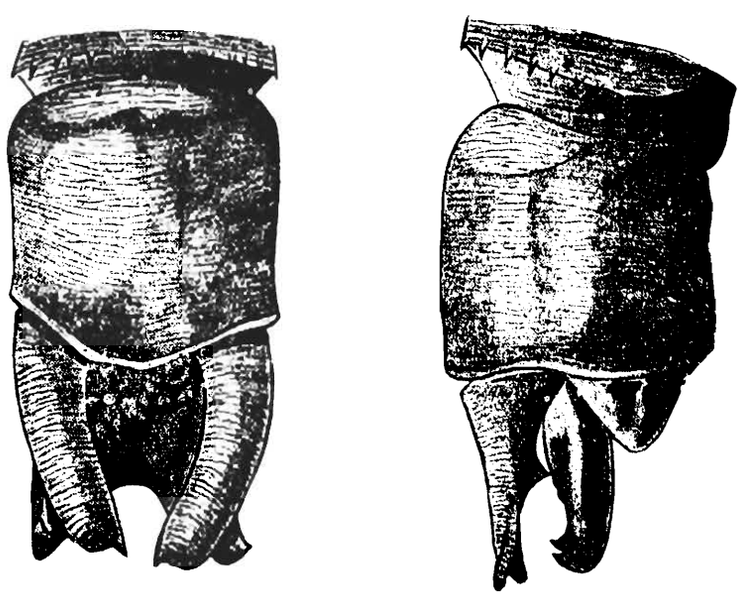
Prothorax black with a small spot of greenish yellow on each side.

Thorax black marked with bright greenish yellow as follows,—an oblique narrow antehumeral stripe on each side of dorsum, slightly dilated above, tapering below ; humeral stripe absent ; a pair of broad lateral stripes on each side, one posthumeral, the other, which is nearly half as broad again as the first, covering almost the entire metepimeron ; between these two stripes a vestigial third made up of two small spots. Beneath blackish brown with a fine yellow stripe.

Legs black, coxae and trochanter of first pair of femora yellow, and a large spot of the same colour near the trochanter of hind pair.

Wings hyaline, uncoloured or palely tinted yellow ; pterostigma black, short, narrow, covering about 2 cells ; discoidal cells a little variable in the fore- and hind-wings, that of fore-wing usually 2-celled but occasionally entire, small, its costal and distal sides equal and longer than base, that of the hind-wing 2 or 3-celled, by transverse nervures or by three meeting at centre of cell, its distal side a little longer than the costal and basal which are nearly equal ; 5 to 6 cubital nervures ; only a single median nervure to all wings ; 7 to 8 cells in anal loop ; anal triangle 3-celled ; a single row of cells, or an occasional doubled cell between the origins of *Cuii* and *IA* ; 4 traversing nervures to all supratriangles ; membrane blackish brown ; *IA* bifid at distal end in all wings ; nodal index—$\frac{10-20}{12-16}\Big|\frac{20-12}{16-13}$, $\frac{11-20}{13-15}\Big|\frac{19-12}{15-15}$, *incomplete basal antenodal nervure absent in all wings.*

Abdomen black marked with citron yellow as follows,—segment 1 with a broad apical lateral stripe on each side narrowly connected with a small spot on the ventral border ; segment 2 with a pair of transversely elongate post-jugal spots on dorsum narrowly separated by the dorsal carina, a large pair of spots on each side, one basal covering the rather large oreillet and the surface behind it, the other angulated and filling the ventro-apical corner of segment and confluent above with a pair of apical confluent lunules ; segments 3 and 4 with a pair of fine post-jugal lunules and a pair of confluent apical confluent lunules, segment 3 has also the sides yellow at the extreme base ; segments 5 to 7 similar to 3 and 4 but without the post-jugal spots ; segment 8 with its apical border finely yellow and ending in a minute ventral spot laterally, remaining segments unmarked. Abdomen long and attenuated, segments 3 and 4 constricted, thereafter triquetral and stouter, segment 10 nearly as long as 9.



TEXT-FIG. 32.—Anal appendages of *Chlorogomphus selysi* Fraser, ♂. From the type in Fraser collection.

Anal appendages black, superiors about as long as segment 10, curved gradually in to nearly meet at apices which are rounded but with a minute spine at inner side, thick at base as seen from the side, the apex bifid from the same point of view, a robust ventral spine

situated at about the middle of appendix ; inferior appendage broadly and rather deeply bifid, the branches turning out and a little up to end in two small spines.

Genitalia very similar to that of *C. campioni*, the anterior hamules longer and narrower, the lobe constricted at its middle and more bottle-shaped than scrotal.

Distribution.—Sikkim. Two males taken at Mungpoo in company with *C. preciosus* and *atkinsoni*, British Sikkim, 3,600 ft., May, 1927. Habits and flight similar to *C. campioni*. The species is closely related to *C. atkinsoni* for which I mistook it, having taken it in company with that species. It is at once distinguished by the bright greenish yellow markings of its face as contrasted with the dull brownish unmarked face of *atkinsoni*. It agrees with this species in not possessing an incomplete basal antenodal nervure in any of the wings.

Chlorogomphus atkinsoni (Selys 1878).

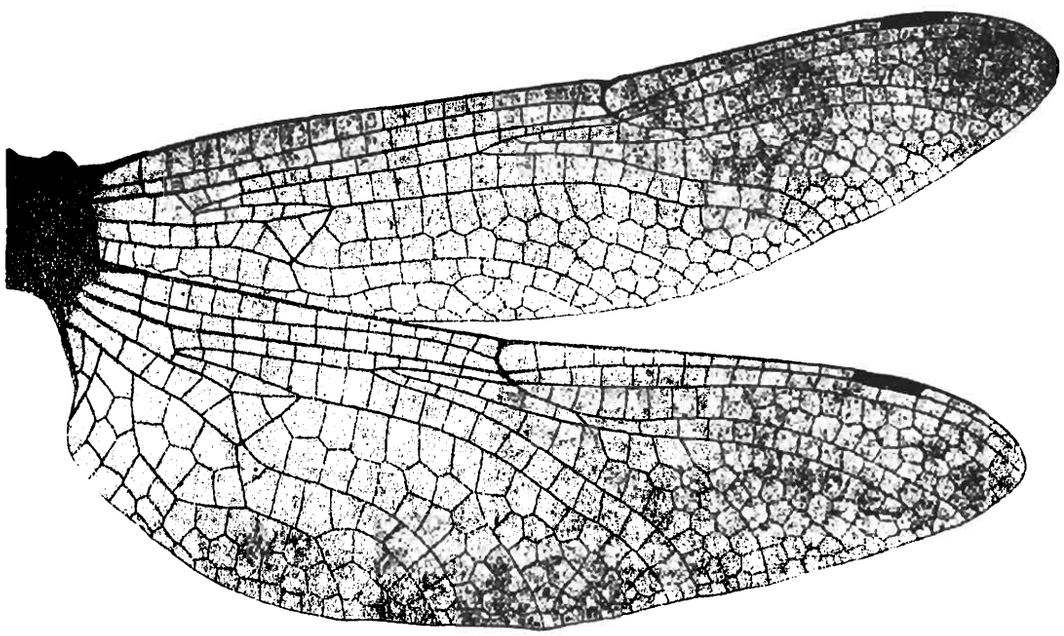
Orogomphus atkinsoni, Selys, *Bull. Acad. Belg.* (2), p. 682 (1878) ; Kirby, *Cat. Odon.* p. 79 (1890) ; Laidlaw, *Rec. Ind. Mus.* XI, pp. 197, 198 (1915) ; Selys, *Ann. Mus. Civ. Genova* (2) X, p. 482 (1891) ; Williamson, *Proc. U. S. Nat. Mus.* XXXII, pp. 278-279, figs. 5-6 (1907) ; Laidlaw, *Proc. Zool. Soc. London*, pp. 61-62 (1914).

Male.—Abdomen 55-58 mm. Hind-wing 39 mm.

Head.—Labium pale brown ; labrum, bases of mandibles, face and frons light brown, unmarked with yellow ; eyes emerald green during life, dark brown in death ; occiput dark reddish brown fringed with black hairs.

Prothorax reddish brown, unmarked.

Thorax dark blackish reddish brown marked with bright citron yellow as follows,—a narrow oblique antehumeral stripe tapering below, much swollen above where it is only



TEXT-FIG. 33.—Wings of *Chlorogomphus atkinsoni* Selys, ♂. From type in the Selysian collection. (W. C. Davies photo.)

separated from its fellow by the mid-dorsal carina ; a pair of moderately broad lateral stripes on each side, equal in width, the first posthumeral, the second covering the greater part of metepimeron ; lastly a small upper spot lying midway between the stripes ; beneath a bright

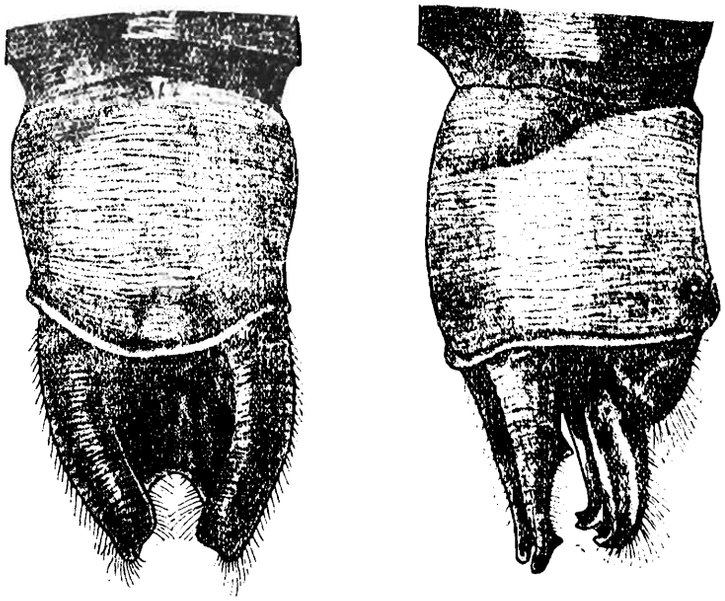
rounded spot of citron yellow framed in a triangle of dark brown and this again in a triangle of bright ochreous bordered by dark brown.

Legs black, anterior pair of femora yellow at base within ; femora with closely-set minute rows of spines.

Wings hyaline, uncoloured, narrow and long ; pterostigma black, short, covering about 2 cells ; discoidal cells shaped very similarly in fore- and hind-wings, but that of hind slightly broader, 2-celled in all wings, costal and distal sides equal in fore-wings, subequal in the hind and both considerably longer than the base of cell ; 1 median nervure in all wings, rarely 2 ; 5 to 6 cubital nervures ; 3 to 4, less commonly 2, traversing nervures in the supratriangles ; anal triangles 3-celled ; nodal index $\frac{11-22}{13-16} \Big| \frac{21-11}{16-14}, \frac{9-21}{13-15} \Big| \frac{22-11}{16-13}$; membrane white ; 6 to 10 cells in the anal loop, usually 8 ; a single row of cells between origins of *Cuii* and *IA*, but occasionally a double cell to begin with. *Incomplete basal antenodal nervure absent in all wings.*

Abdomen much longer than wings, very narrow, tumid at base, narrow and cylindrical at segments 3 and 4, then of about even width to the end. Coloured black marked with citron yellow as follows,—segment 1 brownish yellow ; segment 2 with a pair of small post-jugal lunules widely separated, a small spot on the small oreillets and an obscure spot basal to this, the ventral border narrowly and a pair of large dorsal apical lunules broadly confluent over the mid-dorsum and below narrowly with the ventral marking ; segments 3 and 4 with a pair of small dorsal post-jugal lunules and a pair of apical ones confluent over the dorsum, segment 3 has also an obscure lateral basal spot ; segments 5 to 7 similar but without any post-jugal lunules, segment 8 with a very narrow apical ring ; remaining segments unmarked.

Anal appendages black, about equal in length to segment 10, the inferior slightly shorter ; superiors thick at base as seen in profile, apices blunt, slightly notched, twisted on the long



TEXT-FIG. 34.—Anal appendages of *Chlorogomphus atkinsoni* (Selys) ♂.

axis, a stout mid-ventral tooth only visible in profile ; inferior appendage deeply and broadly notched, its lateral branches upturned and ending in two minute teeth.

Genitalia somewhat similar to that of *C. campioni*, the bosses on the lamina more pronounced, the hamules more attenuated and longer, the lobe rather deeply and narrowly notched at its lip.

Female.—Abdomen 54—58 mm. Hind-wing 40—44 mm.

Coloured and marked exactly as for the male but the post-jugal lunules on segment 2 larger and the apical lunules not usually confluent.

Wings rather broader, 14 to 15 mm. at the broadest part of hind ; extreme bases tinted with golden yellow as far out as the basal antenodal nervure, more rarely the whole wing is palely enfumed ; discoidal cells as for the male but the hind one sometimes 3-celled; nodal index—$\frac{10-22}{15-19}\Big|\frac{19-10}{17-14}$, $\frac{11-22}{14-17}\Big|\frac{21-11}{17-14}$; a single median nervure in all wings ; 3 to 5 traversing nervures to supratriangles ; 11—15 cells in anal loop ; 7 cubital nervures in all wings ; no basal incomplete antenodal nervures present.

Anal appendages small, black, conical, pointed ; vulvar scale short, with a strong median ridge and a short spine at each side.

Distribution.—Bengal (Darjeeling district) in May and June, Assam and the North Punjab. I found it quite common at Mungpoo, 3,600 ft., British Sikkim at the end of May, its habits and soaring flight being altogether similar to *C. campioni*. In flight it much resembled a *Macromia* and as it was often in company with *M. moorei*, the two were frequently mistaken for one another. Larva almost identical to that of *campioni* but the dental folds of gizzard differ by the teeth being sharply pointed at apex and sharply serrate along the borders, the whole of the surface of the anterior pair being coated with some 12 or more spines, but no basal spines as in *campioni*. The mask, like that of the latter, is typically Cordulegasterine in shape.

Atkinsoni is closely related to *selysi* by its shape and markings, and also by the entire absence of incomplete basal antenodal nervures in both sexes. It is distinguished at once from *selysi* by the uniform colouring of the face.

Chlorogomphus dyak (Laidlaw 1914).

Orogomphus dyak, Laidlaw, *Journ. Straits Branch Roy. Asiat. Soc.* p. 121, (1910) ; *Id.*, *Proc. Zool. Soc. London*, pp. 59-60 (1914) ; *Id.*, *ibid.*, p. 312 (1920).

Coll. British Museum, 1 ♂, 1 ♀, (type and cotype) from Matang road, Borneo ; coll. Laidlaw, 1 ♂, Borneo ; coll. Sarawak Museum, 1 ♂, 1 ♀, also from Borneo ; coll. Fraser 1 ♂.

Male.—Abdomen 53 mm. Hind-wing 38 mm.

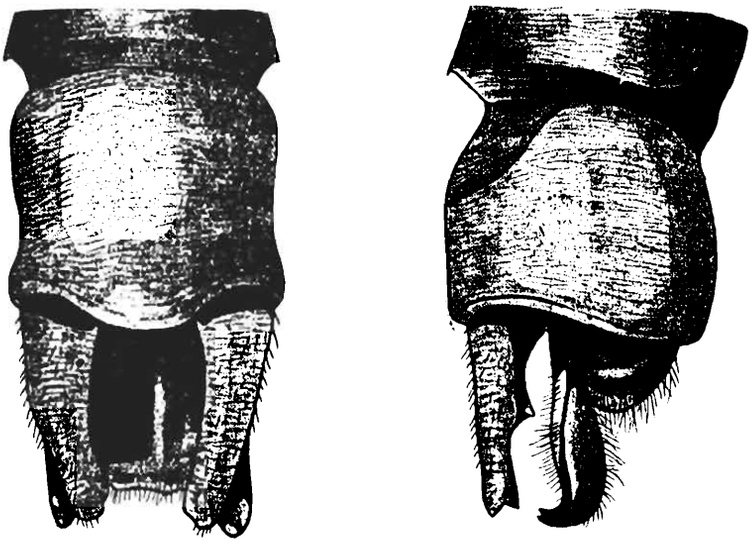
Head.—Labium pale brownish yellow ; labrum black ; anteclypeus dark brown ; postclypeus bright citron yellow ; frons black in front and above, its crest finely citron yellow ; vertex and occiput black, the latter fringed with black hairs ; eyes dark brown, probably emerald green during life.

Prothorax black, with the sides broadly yellow and the border of posterior lobe finely yellow.

Thorax black marked with citron yellow as follows,—a moderately broad antehumeral stripe and a narrower curved humeral stripe expanded above and below and confluent with a mesothoracic collar below ; laterally a narrow oblique stripe and the hinder border of metepimeron narrowly ; beneath brown.

Legs black, base of anterior femora and coxae yellow.

Wings hyaline palely tinted with yellow at the base ; pterostigma black, short, covering about 2 to 3 cells ; a basal incomplete antenodal present in all wings ; discoidal cells 2-celled, that of fore-wing with costal and distal sides equal and much longer than the base, that of hind-wing similar but with costal and distal sides a little subequal (not as marked as in *atkinsoni*) ; anal loop 6 to 7 cells ; anal triangle 3-celled ; supratriangles traversed 4 to 5 times ; nodal index—$\frac{11-21}{15-18}\Big|\frac{21-12}{16-15}$, $\frac{11-21}{12-16}\Big|\frac{24-11}{18-13}$; 3 median nervures to all wings ; 6 to 8 cubital nervures to all wings ; membrane black ; a single row of cells between *Cuii* and *IA* at origins.



TEXT-FIG. 35.—Anal appendages of *Chlorogomphus dyak* (Laidlaw) ♂.

Abdomen black marked with citron yellow as follows,—segment 1 with a fine apical ring ; segment 2 with a spot covering the oreillets and a post-jugal and apical ring confluent laterally to include a large oval black spot ; a pair of post-jugal spots on segment 3 and a confluent apical spot formed of two lunules ; segments 4 and 5 unmarked, but segment 6 with a conspicuous apical ring, broadest on the dorsum, where it is acutely notched ; remaining segments unmarked. Segments 1 to base of 3 dilated, 3 to 6 cylindrical and much attenuated, segments 7 and 8 more than double the thickness of 4, 9 and 10 a little less than 8.

Anal appendages black. Superiors as long as segment 10, thick at base, tapered to apex, which is bifid as seen from the side ; beneath appendage at its middle, a very robust ventral spine after which the appendage rapidly narrows ; inferior appendage slightly longer than the superiors, broadly and rather shallowly notched, the corners turning up abruptly and ending in two small spines.

Genitalia very similar to *C. campioni*, the hamules short and robust, the lobe narrow and slightly notched.

Female.—Abdomen 56 mm. Hind-wing 42 mm.

Colour and markings similar to the male ; wings hyaline or enfumed, this latter, when present, of a golden brown colour and more noticeable at bases and apices of wings, whilst newly emerged specimens have the wings palely tinted with yellow between the node and pterostigma ; nodal index—$\frac{12-22}{14-19}\Big|\frac{23-11}{20-14}$, $\frac{12-22}{14-20}\Big|\frac{22-10}{20-15}$; 10 to 14 cells in anal loop ; 3 to 4 median nervures in all wings, usually only 3 ; 7 to 9 cubital nervures ; supratriangles traversed 5 to 6 times ; incomplete basal antenodal nervure present in all wings discoidal

cells similar to the male but the hind with 3 cells formed by 3 nervures meeting at its centre; a single row of cells between the origins of *Cuii* and *IA* with an occasional double cell.

Anal appendages short, conical, black. Vulvar scale short and inconspicuous.

Distribution.—Borneo. This species stands rather isolated but appears to lie closest to *atkinsoni* and *selysi*, being sharply distinguished from both by the presence of an incomplete basal antenodal nervure. It is the smallest species of the genus. Type and cotype in the British Museum. Mt. Merinjak, 2,200 ft., 28-v-14 and Mt. Matang are given as localities by Dr. Laidlaw.

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