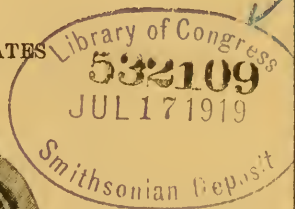


PART I.

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X. *Some Palaearctic species of Cordulegaster.* By
KENNETH J. MORTON, F.E.S.

[Read May 5th, 1915.]

PLATES XXXIV-XXXVII.

DURING recent years a considerable number of examples of the genus *Cordulegaster* have come into my hands from different localities in the Palaearctic region, amongst them some which I have not been able to identify satisfactorily with existing descriptions.

The high standard of excellence in descriptive work reached in the Monographie des Gomphines (de Selys with Hagen's collaboration, Mem. de la Soc. Roy. des Sciences de Liège, Tome xi, pp. 257-720, 1858) does not appear to have been maintained. De Selys' last revision of the species of *Cordulegaster* found in Asia Minor and Europe is too brief and general (Odonates de l'Asie Mineure, Ann. Soc. Ent. Belg., xxxi, pp. 31-35), and does not leave the subject beyond the need of further treatment. The following notes may therefore be helpful as a small contribution to a better knowledge of these splendid insects.

The material dealt with (in addition to ample series of *C. annulatus* collected in Great Britain mostly by myself, but also including series given to me by the Hon. Mr. Rothschild from Devonshire, Mr. Mosely and others) has been received from various sources: France (Morton), Spain (Dr. Chapman, Miss Fountaine, Morton), Switzerland (Dr. Ris), Herzegovina (Miss Fountaine), Constantinople (Mr. Graves), Algeria (Miss Fountaine), the Caucasus (M. Bartenef), Amasia and Van, Asia Minor (Prof. Manissadjian), and lastly, from Messrs. Staudinger and Bang-Haas, Dresden, some very interesting insects from the Caucasus and Fergana.

The species referred to may be divided into two groups—

I. Superior appendages of ♂ with only one visible tooth: group of *C. annulatus*.

II. Superior appendages of ♂ with two teeth: group of *C. bidentatus*.

TRANS. ENT. SOC. LOND. 1915.—PARTS III, IV. (JUNE.) T

***Cordulegaster annulatus*, Latr.**

♂. Face yellow with black hairs; a short transverse rather broad black frontal line; rhinarium black, forming a broad transverse band which encroaches slightly upon the anterior margin of the nasus; labrum yellow, narrowly bordered with black at base and on the sides but not in front, the black forming a little projection in the middle (virgule) not reaching the margin. Labium and palpi reddish yellow; vertex and ocelli black, this colour also bordering in a sinuous manner the base of the frons and descending narrowly along the eyes; occiput small, yellow, furnished with a crest of yellow hairs; it is swollen especially behind, where it is almost bi-vesiculous, marked with a sunken black point. Back of the eyes black with a white band bordering the eyes towards the genae.

Eyes of a brilliant green in life.

Prothorax black, bordered with yellow in front and behind, where this colour is interrupted in the middle of the margin.

Thorax hairy, black marked with yellow, thus: two cuneiform bands in front, and two oblique isolated equal bands on each side, the last not terminal. Between these bands a line divided into two or three spots or entire. There are also an upper humeral point, a point at the wing attachments, an inter-alar spot between each of the wings, double between the hindwings; finally, the basal articulation of the legs and the breast are marked with yellow.

Abdomen cylindrical; constricted between segments 2-6, a little broader between 7-8, shining black, annulated and spotted with yellow, thus: 1st segment with a half-ring interrupted before the end; 2nd with a dorsal ring, rather broad, median above, becoming basal upon the sides comprising the oreillettes which are moderate, denticulated with black at the end, and a second ring, terminal, interrupted by the dorsal arête and sometimes upon the sides; 3rd, 4th, 5th, 6th with a moderate median ring, and a narrow posterior one divided in two by the dorsal arête, which remains black; these rings do not exist on the under side of the segments; 7th and 8th having the rings a little nearer the base, more interrupted in the middle; the terminal ring absent on 8th; the 9th with a little basal lateral spot; 10th quite black, its posterior margin a little projecting and depressed in the middle.

Anal appendages black, superior a little shorter than the last segment, closely approximated at their base, almost compressed vertically, a little divergent; the outer margin thickened, almost straight or a little sinuous; the inner margin tapering to the point, which is fine and sharp, and this side presenting in its first fourth a strong

tooth bent towards the base; the margin is then dilated more or less and slightly emarginate before the point.

Inferior appendage one-third shorter than the superior, almost quadrate, broader than long, a little notched at the end, the lateral margins swollen, turned up at the extremity and pointed.

Legs all black.

Wings hyaline, often a little darkened. Neuration black, costa yellow externally; pterostigma long, slender, black, surmounting nearly 4 cells; membranule rather large long whitish; anal margin little excavated, the angle nearly right-angled. Triangle of the 4 wings divided by a nervule; internal triangle free; 18-21 antenodals in the superior; 13-15 in the inferior; 13-15 post-nodals in both pairs.

♀. Resembles the ♂ in colour, even in the labrum; but the abdomen is less constricted in the middle and the oreillettes very rudimentary.

The vulvar margin is prolonged in two chitinous laminae, surpassing the end of the abdomen by more than 3 mm. They arise at the base of segment 9, are contiguous, are hollow internally, and finish in a point simulating the lower mandible of a *Motacilla*; they are applied against the underside of the abdomen, of which they support segments 9 and 10, which are in some degree soft, their dorsal part being of a nature much less hard than that of the other segments. The base of each of these laminae is marked by a rounded yellow spot which in dried examples becomes often brown. Segment 10 is often marked with yellow on the sides.

The anal appendages, one-third shorter than the last segment, are slender, cylindrical, brown, with a sharp black point, separated by strong protuberance, brown, hairy, which terminates the abdomen.

Pterostigma longer, brown, surmounting 5-6 cells.

	♂	♀
Length of abdomen . . .	55-57 mm.	55-62 mm.
„ forewing . . .	43-45 „	47-50 „
„ hindwing . . .	43-45 „	47-50 „
Pterostigma, forewing . .	4 $\frac{1}{4}$ „	4 $\frac{1}{2}$ -5 „
„ hindwing . . .	5 „	5-5 $\frac{1}{2}$ „
Vulvar lamina . . .	—	8 $\frac{1}{2}$ „

(After de Selys, Mon. des Gomphines, pp. 593-5.)

The principal characters may be summarised thus—

♂. Frons yellow with a transverse frontal line of variable breadth; nasus yellow margined with black anteriorly; rhinarium black;

labrum margined with black posteriorly and at the sides; median virgule of labrum black and well marked. Occiput yellow, swollen above and behind, hairs yellowish. Behind the eyes black with a narrow white line running along the lower part of each eye.

Prothorax black; fore and hind margin yellow, the latter interrupted in the middle.

Thorax with two large cuneiform yellow bands in front, a minute humeral yellow dot; two large lateral bands and between them a narrow irregular band sometimes interrupted.

Abdomen black with yellow markings as follows: on 1st segment a narrow band on the lower posterior part of the segment; 2nd segment with a median dorsal band and a large anterior lower space including the oreillettes, also a narrow posterior band sometimes interrupted on the dorsal arête and on the sides; segments 3 to 8 with median or sub-median bands more or less interrupted by the dorsal arête, 7 and 8 distinctly so; these bands except in 3 not actually touching the ventral suture but carried well over the sides of the segments; each of these segments with terminal lunules (*i. e.* representing the posterior bands) those of the last two being of a small size; 9 with a small lateral spot; 10 entirely black.

♀. Very similarly marked; segment 10 with a small lateral spot.

This typical form is widely distributed in northern and central Europe, including Scotland, Sweden and Denmark, and it goes as far eastward at least as Silesia. In southern France it seems to exist in the Pyrenees, and Navás records it from Portugal and many parts of Spain, including the Sierra Nevada. In other parts of southern France and of Spain it seems to be replaced by *immaculifrons*. De Selys says the latter is found in Italy and Austria, but the distribution of the two still remains to be satisfactorily worked out.

Race *immaculifrons*, Selys.

De Selys (Monographie des Gomphines, p. 595) says that the examples from the south of Europe differ more or less from those of the centre and north in this that the yellow occupies more space on the abdominal segments, while the frons is ordinarily all yellow without transverse anterior line. He gives the following as the principal points which serve to distinguish the best characterised southern examples—

The front is entirely yellow without transverse line; the

black border (proximal) of the labrum does not descend on the sides; the whitish border behind the eyes is broader; the yellow rings of the abdomen are broader and none of them interrupted by a dorsal arête; that of the 8th is much extended on the sides; the lateral spot of the 9th larger, and an analogous lateral yellow point on 10th. In some examples one sees a vestige of the black line on the frons; in others, the dorsal arête on the ring of segment 8 is finely black.

The females differ especially from northern examples by the great breadth of the median yellow rings of the abdomen, which in the 2nd and 3rd segments communicate on each side with the terminal rings in such a way as to isolate a black dorsal spot rounded behind upon the 2nd, pointed on the two sides upon the 3rd; the 8th segment is variable as to the dilatation of the ring, but this ring is always much interrupted above by the black dorsal arête. The front is very rarely entirely without spot; there is ordinarily a vestige. The black border of the labrum is incomplete as in the ♂. The wings in both sexes are often darkened (smoky at the extremity). In some examples they seem narrower than in the type and the costa externally is of a clearer yellow. (After de Selys.)

In a series of 9 males from Digne, Basses Alpes, there are two more or less distinct types of pattern, A being much the commoner. In B the yellow markings are more extended, and on the three last segments noticeably so. 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 slight trace of this marking. Unfortunately I do not appear to have captured a ♀ in this locality.

In Spain the species is very interesting. 1 ♂ 2 ♀♀ from N.W. Spain (♂, Casayo. 2-8, vii. '06; ♀♀, Vigo, 18-27, vi. '06; Branuelas, 10-16, vii. '06, Chapman) are very close to northern *C. annulatus*. The frontal line is well marked in all; the sides of the 3 last segments in the females are rather more marked with yellow than in northern examples.

At La Granja, where the species is abundant at the clear streams there, the males are very similar in appearance to those found at Digne (form A); a fair proportion (4 out of 9) having the frontal line marked in varying degrees. A ♀ does not differ very greatly from the N.-W. Spanish females, but the yellow rings are rather broader and the frontal line is absent.

Unfortunately I failed to take the species at Albarracin, but I possess a ♂ from there (Miss Fountaine, 29, vi. '03) which shows a tendency towards the Algerian examples mentioned below. The shape of the dorsal marking on 2nd segment is much as in Fig. 5. The virgule on labrum is rather paler.

My acquaintance with *Cordulegaster* from northern Africa is restricted to three fine males from Algeria given to me by Miss Fountaine. On the whole these seem to be sufficiently well characterised to deserve a distinctive name.

Race *algericus*, nov.

♂. Frons yellow without transverse frontal line; nasus yellow with the exception of two short black anterior lines; rhinarium black; labrum with the proximal margin black; virgule brownish; occiput yellow with yellow 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; posterior lunules large and connected by a narrow line with the lower yellow patch; dorsal black marking trilobate on anterior margin, the middle lobe narrowest and most prominent. On 3rd segment yellow dorsal marking occupies about $\frac{1}{3}$ of segment and is continued cephalad to the ventral suture and proximal edge of segment; in segments 4, 5 and 6 dorsal yellow markings not occupying quite $\frac{1}{3}$ of segment; yellow on 7th about $\frac{1}{3}$ 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: forewings 17-19; hindwings 12-14.

Length of abdomen 55-58 mm.

Length of wings 44-46 mm.

Pterostigma of forewings $3\frac{1}{2}$ -4 mm.

„ hindwings $4-4\frac{1}{2}$ mm.

3 ♂♂: Sebden, 29, vi. 9. vii. '04; Tlemcen, 14, vii. '04.

Some time ago I received from Staudinger of Dresden a pair of *Cordulegaster* bearing the label "Tiflis Caucasus." They rank amongst the finest of the *C. annulatus* group, and, supposing no mistake has been made regarding the locality, they are of particular interest in respect that they appear to be nearer to the African than to the other races.

Race *princeps*, nov.

♂. Frons yellow without black markings; nasus yellow, rhinarium black; labrum yellow, basal margin bordered with black; *virgule not marked with black*; occiput yellow with yellowish hairs, swollen above and behind, deeply divided behind. *Behind the eyes entirely whitish with the exception of a black border running along the upper part of the eyes.*

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

Thorax: antehumeral yellow bands preceded by a small yellow sub-triangular marking; yellow line between lateral bands small, broken up into three short lines all above stigma; no humeral dot visible.

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 side, but leaving a large yellow space including the oreillette on the lower anterior part of the segment; segments 3 to 7 with yellow dorsal markings occupying more than one-third of the segment, these markings extending laterally more in their anterior part but in no case reaching the ventral suture; a broad yellow band on segment 8, nearly reaching ventral suture; 9 segment marked with yellow anteriorly; and there seem to be traces of yellow on both anterior and hind margin of segment 10. Segments 2 to 6 with posterior lunules. Superior appendages from above much as in *annulatus* but longer, as long as last segment; outer margin nearly straight; closely approximated at the base, their inner margins, from the tooth, diverging regularly till about $\frac{1}{4}$ from the apex where they become parallel for a short space and then again diverge to the acute apex. Inferior appendage rather deeply emarginate.

♀. Similar: thorax with a small humeral spot. Abdomen: yellow dorsal marking on 2nd segment continued without interruption on the sides cephalad; segments 3 to 7 marked much as in the male; about half of dorsum of 8 yellow; yellow on 3, 4, 5 and 8 interrupted by black dorsal arête; segments 9 and 10 discoloured.

Wings in both sexes with the costa clear yellow. Antenodals: ♂, forewings 19–20, hindwings, 14; ♀, forewings 17, hindwings 12–14.

	♂	♀
Length of abdomen . . .	59 mm.	61 mm.
„ wings . . .	46.5 „	47 „
Pterostigma, forewings . .	3.5 „	4 „
„ hindwings . . .	4 „	4.5 „
Vulvar lamina	—	8.5 „

Cordulegaster charpentieri, Kol.

♂. Frons yellow with fine black transverse line. Nasus yellow marked with black in front; rhinarium black. Labrum distinctly and completely surrounded with black margin; virgule black and distinct. Occiput above with black margins and blackish in the middle dividing the disc into two dusky yellowish patches; behind yellow, divided for a great part of its length by a dark line; hairs blackish. White line behind the eyes broader than in *C. annulatus*.

Thorax: humeral spot distinct; intermediate lateral band divided into two—a long spot of nearly equal breadth and a smaller triangular spot above the stigma.

Abdomen: lower part of distal half of 1st segment yellow; yellow dorsal band of segment 2 occupying about $\frac{1}{4}$ of segment, almost interrupted on side, the yellow again extending to the proximal margin and including the oreillette; black dorsal marking trilobate, middle lobe prominent; lunules distinct, not connected with lower lateral yellow markings. Yellow on segment 3 extending to fully one-third on dorsum; on 4 to about $\frac{1}{3}$; on 5, 6, 7 and 8 to about $\frac{1}{4}$; most of the median bands divided by the dorsal arête but otherwise nearly complete and continued to the ventral suture. Lunules apparently not indicated after 6th segment.

Appendages similar to those of *C. annulatus* but rather longer; narrower when viewed from above, divergent, turning slightly outwards towards the apex which is acute. Distal margin of inferior appendage nearly straight. (Compare Mon. Gomph., pl. 17, figs. 4 and 5, from Tuscany and Dalmatia.)

Antenodals: forewings 19–21; hindwings 12–14.

Length of abdomen	. . .	57–58.5 mm.
„ wings	. . .	46–48 „
Pterostigma, forewings	. . .	3.75–4 „
„ hindwings	. . .	4.25–4.5 „

I am indebted to Monsieur Bartenef for a ♂ from Lagodechi in Kaketia, the locality whence came de Selys' examples described in Odonates de l'Asie Mineure. Two examples from Belgrade Forest, Constantinople, differ slightly therefrom and *inter se*. In one the transverse frontal line is heavy, in the other it is absent; the dorsal yellow band of segment 2 is if anything broader, but the other bands are rather less extended above than in the Lagodechi ♂; the lunules are distinct up to segment 7.

I am not at all sure that this is the true *C. charpentieri* of Kolenati, although I think it is certainly in the main the

C. charpentieri, de Selys, Odonates de l'Asie Mineure (Ann. Soc. Ent. Belg., xxxi, p. 32, 1887).

Regarding *C. pictus*, Selys, I can come to no definite conclusion. It must remain doubtful without an examination of the ♀ type, which may belong to one of the other recognised species. De Selys made various attempts to find a suitable partner for it, with not very satisfactory results as the following notes show.

1854. *C. pictus*, Syn. Gomph., No. 111, p. 87, ♀ of unknown origin, doubtfully from India.

1856. *C. bidentatus* race *pictus*, Mon. Gomph., p. 340 or 600; ♂ from Broussa; ♀ probably the above.

= 1873, ♂ *C. bidentatus* race *anatolicus*, Syn. Gomph., 3rd Addns., p. 65.

= 1887, ♂ *C. bidentatus* (very probably), Odonates de l'Asie Mineure.

= 1887, ♀ *C. pictus*, Odonates de l'Asie Mineure.

1873. *C. pictus*, Syn. Gomph., 3rd Addns., p. 43, Caucasus, etc.

= 1856, *C. annulatus* race *intermedius*, Mon. Gomph., p. 336 or 596 from Tuscany and Dalmatia.

= 1887, *C. charpentieri*, Odonates de l'Asie Mineure, from Caucasus.

1887. *C. pictus*, Odonates de l'Asie Mineure, represents the original ♀, and ♂♂ of *C. annulatus* race *intermedius* from Tuscany and Dalmatia. But I believe the last-mentioned race = *C. charpentieri* of the Odonates de l'Asie Mineure, as represented by the Caucasus ♂♂, with which, under the name of *C. pictus*, de Selys himself had associated the race *intermedius* of *C. annulatus* in 1873.

***Cordulegaster bidentatus*, Selys.**

The principal differences between this species and the northern form of *C. annulatus* are given by de Selys as follows—

♂. 1st. The black line of the front is a little longer and more constant, slightly upturned at the ends; it is limited by the frontal crest, while in *annulatus* it is placed a little lower.

The excavation of the frons is a little differently constructed; the base of the front before the ocelli is less margined with black.

2nd. The labrum is always markedly margined with black on the

sides, and the anterior margin is equally bordered very lightly with black.

3rd. The little triangle forming the occiput in front is blackish, surmounted with a crest of hairs mixed of blackish and yellowish-grey; this occiput is not vesiculous before or behind; behind it is yellow with a black sunken line.

4th. The yellow line between the two lateral bands is absent or much interrupted (reduced to an upper spot in the female).

5th. Although the median yellow rings may be narrow, those on segments 7-8 constantly reach the ventral suture. The 10th segment has a yellow spot on each side; the 2nd, 3rd and 4th segments have on each side a narrow yellow transverse terminal line, interrupted on the dorsal arête, but this vestige is absent on the following segments.

6th. The superior anal appendages are notably separated from each other and narrower at their base. Besides the internal sub-median tooth which is a little further removed from the base (being almost in the middle) there is towards the first fourth a second external lateral tooth also inclined towards the base, both of these teeth being visible in profile view.

The inferior appendage is about $\frac{3}{4}$ as long as the superior, longer than broad, a little constricted at the extremity which is not appreciably notched.

7th. The costal nervure is hardly yellow outwardly. The pterostigma is shorter, the large cellule near the membranule is almost always divided into three, rarely four cellules. In *annulatus* it is ordinarily divided into five.

♀. Differs from *annulatus*—

1st. (See above, No. 1.)

2nd. The labrum always broadly bordered with black on all sides, even in front, the virgule reaching the anterior margin and dividing the yellow into two.

4th. (See above, No. 4.)

5th. Colours of abdomen as in the ♂, but differing from *annulatus* in the absence of the yellow spots at the base of the vulvar laminae and by the form of the yellow ring of the 8th segment, much interrupted and consisting of only two yellow lines.

6th. The costal nervure is blackish outwardly, or only finely yellowish between the nodus and pterostigma; the latter shorter and blackish.

	♂	♀
Length of abdomen . . .	50-56 mm.	55 mm.
„ forewing . . .	42-45 „	49 „
„ hindwing . . .	42-45 „	49 „

	♂		♀
Pterostigma, forewing . . .	3½	„	3¾
„ hindwing . . .	3¾-4	„	4
Vulvar lamina	—		9½

(Mon. des Gomphines, pp. 599-600.)

The principal characters of *C. bidentatus* are—

Frons yellow with a very strong transverse frontal line; nasus very narrowly margined with blackish at the junction with the rhinarium and also with two blackish spots; rhinarium black; labrum with black margin all round and a strongly marked virgule. Occiput above black with blackish hairs; behind yellowish, not swollen, nearly bisected with a darker line.

Prothorax with interrupted median and posterior line.

Thorax: no humeral dot; lateral intermediate band variable usually much reduced sometimes to a mere point.

Abdomen: 1st segment with an oblique lateral spot not descending to ventral suture; 2nd segment with a narrow dorsal yellow band occupying about ⅓ of segment, almost isolated from the large anterior lateral yellow spot (this band continued without interruption in ♀); lunules rather large, cut off from lower posterior spot; bands of segments 3 to 8 variable, mostly rather narrow, those of 6, 7 and 8 usually more so than the others, usually all interrupted by the dorsal arête, 7 and 8 at least reaching the ventral suture. Traces of yellow on the anterior part of segment 9. Posterior lunules on 2, 3 and 4.

Actual distribution not quite ascertained. Ris (Süsswasserfauna Deutschlands, Odonata, p. 23) says west and southern Europe. It occurs in Herzegovina and perhaps further east, it may be, even extending to Asia Minor. Calvert (Proc. Acad. Nat. Sciences Philadelphia, 1898, p. 152) records it from Kashmir, but his insect is certainly not the typical form. Examples from Digne (Basses Alpes) are very similar to Swiss specimens, showing no variation corresponding to the southern characters displayed by *C. annulatus* in the same locality. A male from Mostar in Herzegovina is also very similar, the yellow bands being only a little stronger, with traces of yellow even on segment 10. Females from Jablonica have the black margin of the labrum exceedingly broad, so that the virgule practically touches the anterior margin, thus dividing the yellow of the disc in two. De Selys, as mentioned above, says the virgule touches the anterior margin, but this is not always the case.

The following three forms are referred to *C. insignis*, Schneider, provisionally, although they differ from one another very considerably in appearance. Further material from other parts of Asia Minor is much to be desired, and also examples from the European side. *C. insignis* has been recorded from Roumania, but in what form it exists there I do not know.

***Cordulegaster insignis*, Schneider.**

Differs from the meridional form of *annulatus*.

♂. 1st. The front hardly excavated, always yellow without a black line; that of the base before the ocelli almost absent.

2nd. Labrum very lightly margined with brown in front without coloured median virgule.

3rd. The occiput is yellow swollen in front and behind as in *annulatus*, but surmounted by a crest of shorter yellow hairs. The lower whitish-yellow part behind the eyes larger.

4th. The yellow line between the large lateral bands on the thorax reduced to a fine superior line more or less interrupted (as in *bidentatus*). The two yellow bands on the front of the thorax are a little broader inwards.

5th. The abdomen is less thickened before the extremity. The yellow rings of the 3rd, 4th and 5th segments broader, occupying nearly their median half; on the 6th and 7th the yellow ring has the same dimensions as in the preceding, but it is forked behind on the dorsum, and constricted upon the sides also behind, so that it ends in two little yellow points; on the 8th the ring is regular, not constricted upon the sides, straight behind, nearer the base than the posterior end; on the 9th and 10th the lateral yellow spots (one or two on 9th; one on 10th) are larger and better marked.

6th. The appendages are almost of the form of those of *bidentatus*, the superior being separated from their base and provided beneath with two teeth. They are black, brown at the tips; the inferior is as long as broad.

The wings are as in *bidentatus*, the pterostigma being shorter than in *annulatus*, and the large space near the membranule of the hindwings divided into 3 cellules only. 15-18 antenodals in forewings, 13 in hindwings. Costa outwardly strongly margined with yellow.

♀. Differs from that of *annulatus* as follows—

1st. The black line on the summit of the front is very fine and very short; the front less excavated, the black basal line before the ocelli almost absent.

2nd. The upper lip (labrum) finely bordered with blackish even in front (with the median virgule more slender).

3rd. The occiput and back of the eyes (see the male).

4th. Thorax (see the male).

5th. Abdomen (see the male).

6th. The base of the vulvar laminae dark brown (in *annulatus* they are marked each with a yellow spot).

The wings are a little broader, pterostigma shorter, the costa more finely yellowish externally. 18 antenodals in forewings; 13-14 in hindwings.

Compared with *bidentatus*, *insignis* differs from it: the ♂ by the labrum less bordered with black, the median virgule obliterated, the front less excavated, without anterior line; the occiput yellow, globular; the two yellow bands on the front of the thorax broader; the broad yellow bands of the abdomen; the inferior teeth of the appendages a little stronger; the costa more yellowish externally. The ♀ is distinguished by the labrum much less bordered with black; the median virgule smaller; the front less excavated with anterior line very slender and short; its base in front of the ocelli less blackish, the occiput yellow, globular; the two bands in the front of the thorax broader; the yellow rings of the abdomen broad; the costa yellow externally.

	♂	♀
Length of abdomen . . .	57-58 mm.	57-62 mm.
„ forewing . . .	47 „	48-51 „
„ hindwing . . .	46 „	47-49 „
Pterostigma, forewing . . .	3½ „	3½-4 „
„ hindwing . . .	4 „	4-5 „
Vulvar lamina	—	7½-8 „

Described from two males and two females from Syria and a ♀ from Kellensch, Asia Minor (Mon. des Gomphines, pp. 603-4).

The following observations are based on material in my own collection. Nearly all the specimens have been slightly altered by pressure, and I am unable to confirm with absolute certainty the above statement that the abdomen is less thickened than in *annulatus*, but it is probably correct. Otherwise the specimens are nearly all in very good condition.

I. A ♂ from Asia Minor without more definite locality agrees fairly well with the above description. It may be from the Taurus Mountains whence Prof. Manissadjian (from whom the whole material of this species was received)

sent me a few dragon-flies. In this example, on 1st segment of abdomen there is a broad oblique lateral band not reaching quite to the ventral suture. The yellow dorsal band of 2nd segment is not broad but is continuous with the anterior lateral yellow marking; the black dorsal marking of this segment with a prominent middle lobe; hind lunules well marked, broadly disconnected with the lower lateral posterior marking, which is small; lateral marking on segment 9 basal only; none on segment 10.

Antenodals: forewing 14; hindwing 11.

II. Race *amasinus*, nov.

From Amasia there is a series of 4 males in which the yellow dorsal markings are much more highly developed, being present even on 1st segment in a limited degree. In this segment the lateral markings are variable, in one case at least nearly reaching the ventral suture. Lunules on segments 2, 3 and 4 sometimes not interrupted by the dorsal arête, and may be represented on all the other segments to the 8th or 9th; 9th and 10th showing both anterior and posterior lateral markings. The nasus is entirely yellow.

In two females presumably from the same locality, there is a trace of the anterior line on the frons, but the virgule on the labrum, though distinctly present, is entirely unicolorous with the disc. The nasus is very slightly marked with brownish on the anterior margin.

Antenodals: ♂, forewing 16-17; hindwing 11-12; ♀, forewing 15-16; hindwing 12.

De Selys in his notes on *C. insignis* does not refer to the colours of the prothorax. It should be here noted that in form I the posterior yellow line is broadly interrupted and short; there is also an interrupted median yellow line, with two yellow dots between it and the posterior margin; the anterior margin is also yellow. In II (*amasinus*) the posterior yellow line is interrupted but much longer, and the other yellow markings on the prothorax are well defined.

III. Race *nobilis*, nov.

At Van, in the extreme east of Asia Minor, near the Persian frontier, there is a still further increase in the yellow markings at the expense of the black ground-colour, if indeed these examples (2 ♂♂, 2 ♀♀) belong to *C. insignis*.

Oddly enough there is no trace of yellow markings on the dorsum of 1st segment, although the segment is rather lighter in colour than in No. I. This is a very beautiful and interesting form. Dr. F. F. Laidlaw tells me that in the collection of the Indian Museum there are two specimens ♂ and ♀ labelled in de Selys' own handwriting, "*Cordulegaster nobilis*," and dated "May '71, Shiraz," Persia; the ♂ he states is indistinguishable from the ♂ from Van as represented in my fig. 11, which I sent to Dr. Laidlaw for inspection. No description of these appears to have been published.

The following characters may be mentioned—

Prothorax: the posterior band is not completely interrupted in the middle, although a narrow black wedge is partly driven into it; the lateral angles are yellow and the posterior and the interrupted median line are practically confluent therewith. Yellow abdominal bands much extended, the greater part of most of the segments yellow; for these, see fig. 11; these yellow markings are continued more narrowly on the sides cephalad, and up to the 8th reach the ventral suture in the ♂ and nearly so in the ♀.

Antenodals: ♂, forewings, 14-15; hindwings, 11-12; ♀, forewings 15-16; hindwings, 11-12.

The following are approximate measurements—

	Locality?		Amasia.		Van.	
	♂		♂	♀	♂	♀
Length of abdomen	50 mm.		52·5-53·5 mm.	60-63 mm.	50-52 mm.	60 mm.
" wing	41·5 mm.		43-44·5 mm.	48-50 mm.	41·5-43·5 mm.	46-47·5 mm.
Pterostigma, forewing	3·5 mm.		3·75 mm.	4 mm.	3·5-4 mm.	4 mm.
" hindwing	3·75 mm.		4·25 mm.	4·5 mm.	4-4·5 mm.	4·5-5 mm.
Vulvar lamina	—		—	8-8·5 mm.	—	8 mm.

The males would therefore appear to be smaller than those from Syria.

The last species to be noticed is closely allied to *C. bidentatus* and *insignis*, but it has been treated as an independent species. It differs from *C. insignis* in the condition of the labrum, which has a distinct black median virgule.

Cordulegaster coronatus, n. sp.

♂. Frons yellow without black frontal marking; nasus yellow with two black points; rhinarium black; labrum yellow with very narrow border black but becoming brownish on anterior margin, usually

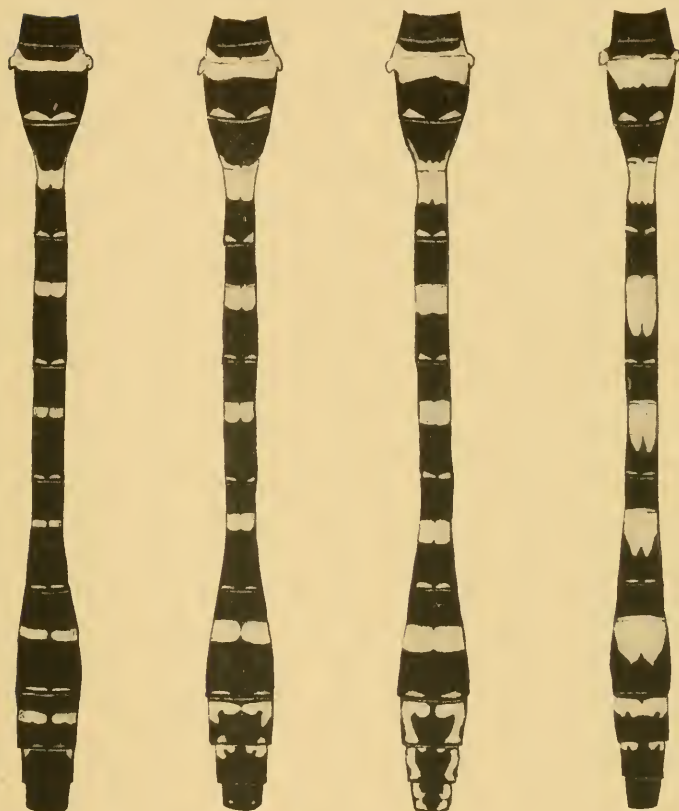
with a strongly marked virgule; mandibles externally yellow; genae black; occiput yellow with yellowish hairs; labium yellowish. Vertex black obscurely marked with yellowish, the black hardly encroaching on the frons and continued very narrowly downwards alongside the eyes. Occiput hardly swollen; behind yellow divided to the extent of about half by a blackish virgule. Behind the eyes whitish with a broad black border.

Prothorax black bordered with yellow in front and behind, with two median yellow dots and a broken median line which becomes confluent with the posterior yellow border.

Thorax in front with long silky hairs; black marked with yellow thus: two large cuneiform antehumeral bands in front enclosing a large black triangle, and two broad oblique lateral bands of almost equal breadth; between these an interrupted line broken up into four, the large upper part somewhat wedge-shaped, followed by a minute elongate spot and a spot on each side of the stigma; no humeral dot visible; a yellow spot at the wing attachments above; a yellow inter-alar spot, double between the hindwings. Coxae yellowish, sternum yellow with fuscous markings.

Abdomen cylindrical, constricted after 2nd segment, and gradually increasing in breadth to 7th and 8th, the remaining segments again narrower. Basal segment slightly brownish with traces of a yellow spot at the extreme base. Abdomen otherwise black and yellow. 1st segment with yellow lateral markings both anterior and posterior variable in extent; 2nd mostly yellow dorsally with a black basal band followed by two fine black dashes, a black, sometimes isolated, usually roughly oval dorsal spot; posterior margin finely black; segments 3, 4, 5, 6 and 7 with large dorsal yellow markings partly divided by the dorsal arête, on 3 occupying about $\frac{2}{3}$ of the segment, on 4 the spots occupying about $\frac{1}{2}$ of segment; on 5, 6 and 7 less than $\frac{1}{2}$, each of these five segments with posterior yellow lunules or bands. Segments 8, 9 and 10 mostly yellow with large dorsal black patches. Margins of segments ventrally finely lined with yellow along the ventral suture.

Appendages black. Superior about the length of last segment, separated at the base. Outer margin in dorsal view nearly straight, tip acute: inner margin about $\frac{2}{3}$ from base forming a tooth from which to the base the breadth is less; in profile view broader at the base where there is a large tooth with apex directed cephalad, and the appendage tapers slightly to the acute apex which is somewhat upturned. In profile view the median tooth is smaller than the other with its apex pointed in the same direction. Inferior appendage rather over half as long as the superior, broad with nearly parallel sides, slightly emarginated at the upturned apex.



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1

2
A

3
B

4

PALAEARCTIC SPECIES OF CORDULEGASTER.



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5



6



7



8

PALAEARCTIC SPECIES OF CORDULEGASTER.



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9



10



11



12

PALAEARCTIC SPECIES OF CORDULEGASTER.



Photo, W. E. Evans.

♀. Similar (single example somewhat discoloured). Posterior dorsal spot of 2nd segment isolated (almost as in fig. 12); yellow on segments 2, 3 and 4 occupying more than $\frac{1}{2}$ of each segment, on 5, 6 and 7 about $\frac{1}{2}$, 8 black (discoloured?), 9 and 10 mostly yellow, dorsum of 9 broadly marked with black, 10 with two irregular elongate blackish markings broad at the base and becoming lighter towards the hind margin where they terminate in a definite black dot. Costa yellow externally in both sexes. Antenodals: ♂, forewings 13-16; hindwings, 10-12; ♀, forewings, 14-15; hindwings, 11.

	♂	♀
Length of abdomen	53-55 mm.	59.5 mm.
„ wing	43-45 „	48.5 „
Pterostigma, forewing . . .	3.5 „	4 „
„ hindwing	4-4.5 „	5 „
Vulvar lamina	— „	7 „

The dorsal marking on 2nd segment in fig. 12 represents an extreme form; it is usually more oval in outline but frequently showing little wing-like lateral projections. The dorsal markings generally show some variability in their extent in different specimens.

7 ♂♂, 1 ♀, Kokand, Fergana.

I am unable to give serviceable figures of the appendages of the various species, but think the diagrams showing the distribution of the black and yellow markings on the abdomen may be of use. These are not drawn to scale, but the measurements of the abdomen are given for each species.

Other species of the genus have been noticed from the more eastern parts of the region, but of these I possess no material.

It may be well to explain the difference in the references here given to the pages of the *Monographie des Gomphines* when compared with those given in Kirby's *Catalogue*. Mr. Kirby and other authors, including de Selys himself, appear to have made use of "separates" of the *Monographie*. There fall to be added to Kirby's figures, 260 pages, to make them correspond with those here quoted. The inaccuracy of the date quoted by Kirby has already been pointed out by Calvert (*Biol. Centr.-Amer., Neuropt., Odonata*, p. 148, 1905). De Selys himself, however, had already stated in the introduction to the *Additions au Synopsis des Gomphines* (*Bull. de l'Academie Royale de Belgique* (2), vii. 1859) that the *Monographie* was only published in 1858.

It may also be pointed out that in the Synopsis des Gomphines (1854) and in the Monographie, the characters of the two groups, as far as the teeth of the superior appendages are concerned, have been transposed. Correction of this error is made in the Secondes Additions au Synopsis des Gomphines (Bull. de l'Acad. Royale de Belgique (2), xxviii. 1869).

EXPLANATION OF PLATES XXXIV-XXXVII.

PLATE XXXIV

- FIG. 1. *C. annulatus*, New Forest.
 2. „ „ *immaculifrons*, Digne, form A.
 3. „ „ „ „ „ B.
 4. „ „ *princeps*, Tiflis.

PLATE XXXV

5. *C. annulatus algiricus*, Sebdou, Algeria.
 6. „ *charpentieri*, Caucasus.
 7. „ „ Constantinople.
 8. „ *bidentatus*, Mostar.

PLATE XXXVI

9. *C. insignis*, loc. ?
 10. „ „ *amasinus*, Amasia.
 11. „ „ *nobilis*, Van.
 12. „ *coronatus*, Kokand, Fergana.

PLATE XXXVII

13. *C. coronatus*, Kokand, Fergana, from another specimen (photo : W. E. Evans).