

A SURVEY  
OF THE DRAGONFLY FAUNA OF MOROCCO (ODONATA)

BY

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(With one map and 32 figures)

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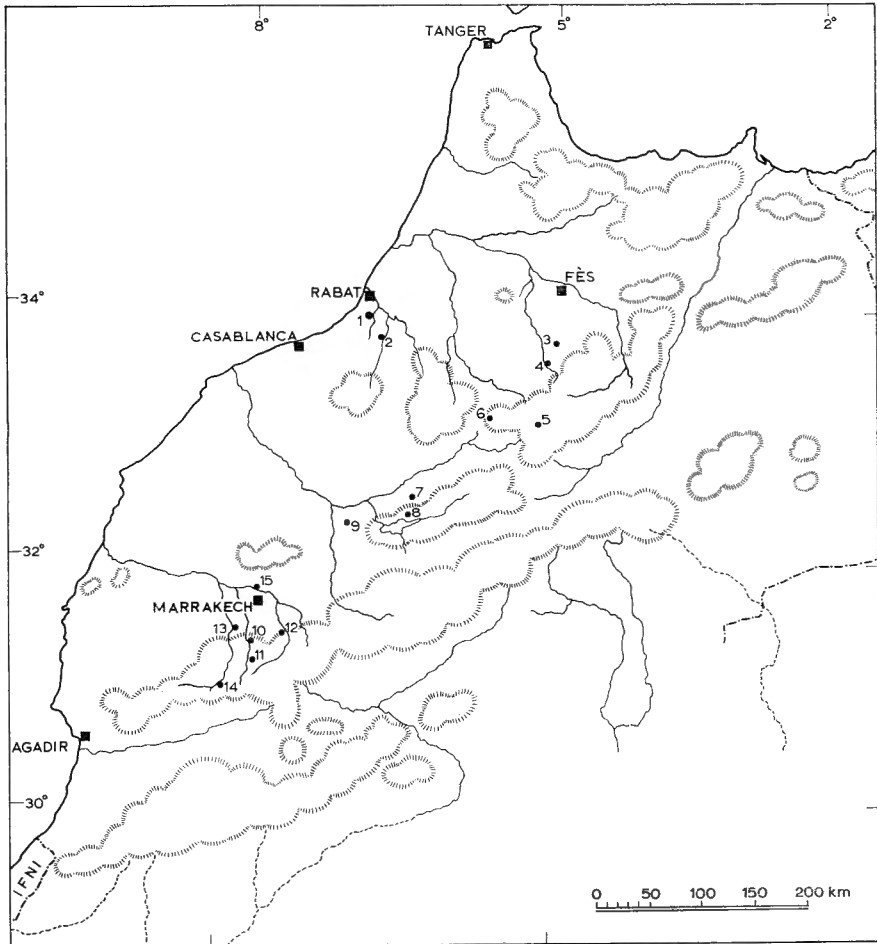
This paper is to be regarded as a critical contribution to our knowledge of the dragonfly fauna of Morocco. It is based principally on captures made by the writer during a holiday trip with his wife to this country during the last weeks of May and the beginning of June, 1966. The region covered may be described roughly as that which is accessible by car from Rabat at the Atlantic coast towards the east and south for visits, often of brief duration, to places of scenic as well as entomological interest. To avoid repetition, the places where collecting was done during this journey are numbered, the locality numbers enumerated under the heading of each species in the text referring to those given in the following annotated list, which is arranged in chronological order (see map).

LIST OF COLLECTING LOCALITIES.

Loc. 1. — NW Morocco, Oued Akrech, 17 km S of Rabat, 17-V-1966. Shady rivulet, ponded in places, in low hilly country. Rich aquatic vegetation of *Myriophyllum* and *Potamogeton* cf. *natans*. Collecting en route for about one hour, favoured with still weather and bright sunshine. Alt. ca 150 m.

Loc. 2. — NW Morocco, Gorges of the Oued Korifla, 42 km S of Rabat, 17-V-1966. Larger stream in open arid country. Little or no submersed vegetation but scattered shrubs with overhanging foliage. A flying visit further south, alt. ca 70 m.

Loc. 3. — Moyen Atlas, Daiet Aaoua, between Fès and Ifrane (8 km S of Immouzer-du-Kandar), 21-V-1966. Large shallow upland lake in



Sketch map of Morocco showing the situation of localities where collections were made by the author. The numbers 1-15 refer to the annotated list of localities on p. 1 to 4 of the present paper.

forested area; western shore sheltered, fringed with big poplars, elder and oak trees; also much shrubbery, sallow saplings and reed fringe; major part of lake exposed and marshy, with rich inshore vegetation of *Polygonum* cf. *amphibium*, *Batrachium* sp., *Potamogeton* cf. *natans*, *Utricularia*, etc. Morning hours fair and sunny with strong winds till 11 a.m. but sky overcast and much colder for the rest of the day. Alt. ca 1500 m.

Loc. 4. — Moyen Atlas, near Ifrane, 26-V-1966. Clear meandering upland stream, Oued Tizquit and tributary brooks in the Val d'Ifrane, mostly flowing through heavy forest. Open and shaded reaches

alternating, with a great variety of shore and aquatic vegetation. Many rocky pools, cascades, sand deposits, gravelly and silt-bottomed stretches. Visited during the morning hours. Weather fair after heavy rainfall during the night; at first misty and humid but sunny periods later in the morning. Alt. ca 1500 m.

Loc. 5. — Moyen Atlas, near Timhadite, 38 km S of Azrou, 27-V-1966. Marshy roadside brook, visited en route to Col du Zad. Alt. 1850 m.

Loc. 6. — Moyen Atlas, Oued Teguet near El Borj, ca 10 km N of Khenifra, 28-V-1966. Small stream with occasional ponded stretches mainly containing *Batrachium* and *Nasturtium* cf. *officinale*. One hour profitable collecting en route. Fine weather. Alt. ca 1000 m.

Loc. 7. — Moyen Atlas, Ain Asserdoun near Beni-Mellal, 29-V-1966. Tiny swift-flowing brook surrounding Citrus gardens, shaded by brambles and lush grass. Collecting during late afternoon; very warm, no wind. Alt. ca 650 m.

Loc. 8. — Moyen Atlas, Ouaouizarht, 35 km SW of Beni-Mellal, 30-V-1966. Small rocky stream with clear, swift running water in semi-cultivated area (olive garden). Shallow ponded places with algae and other submersed vegetation alternating with rocky parts and deep pools below falls. Many frogs and small tortoises. Abundant growth of profusely flowering Oleander and *Crataegus* in stream bed. Several hours' collecting favoured with bright sunshine and no wind. Alt. ca 1500 m.

Loc. 9. — Moyen Atlas, Pont d'Imdahane, Oued el Abid (tributary of Oued Oum-er-Rbia) near Bzou, about 50 km E of Beni-Mellal, 31-V-1966. Flying visit en route. Alt. ca 300 m.

Loc. 10. — Haut Atlas, Asni, valley of the Oued Reraia, ca 48 km S of Marrakech, 1, 7 and 8-VI-1966. Wide exposed stream bed with marshy spots and rivulets overgrown with *Veronica* cf. *beccabunga*, *Berula angustifolia*, *Nasturtium* cf. *officinale* and *Batrachium*. Several hours' collecting, mostly in the afternoon; weather conditions variable, sunny periods but sky often overcast with much wind. Alt. 1150 m.

Loc. 11. — Haut Atlas, Asni to Imlil, ca 60 km S of Marrakech, at foot of Mt. Toubkal, 2 and 6-VI-1966. Silt-bottomed hillside brooks and rivulets in forested area. Collecting often en route; weather unstable with showers and sunny periods. Alt. 1300-1700 m.

Loc. 12. — Haut Atlas, Asguine, about 40 km SE of Marrakech, valley of the Oued Ourika, 4-VI-1966. Brief visit and collecting en route. Alt. ca 1000 m.

Loc. 13. — Haut Atlas, Barrage Cavnac, ca 55 km SSW of Marrakech, 5-VI-1966. Artificial lake and rocky stream, Oued Nfiss, below dam. Slow flowing stream with large boulders (Loc. 13a) and lake with scanty shore vegetation of *Polygonum aquaticum* (Loc. 13b). Collecting during morning hours; weather fine but dry and very windy. Alt. ca 800 m.

Loc. 14. — Haut Atlas, Oued Agoundis near Ijoukak, about 50 km NE of Tizi-n-Test, 8-VI-1966. Meandering river in wide rocky bed, mostly with a slow current; in several spots under right bank almost stagnant deep water with narrow fringe of floating *Potamogeton* cf. *natans*. Abounding in fish, tortoises and snakes. Collecting en route. Alt. 1150 m.

Loc. 15. — South Morocco, valley of the Oued Tensift, 9 km N of Marrakech, 10-VI-1966. Main river system of the flat Marrakech oasis. Wide exposed river bed with extensive mud flats and gravel deposits; moderate to slow flow. Aquatic and shore vegetation only along irrigation channels nearby. Collecting downstream on right bank, between 2 and 4 p.m., in barren country planted all over with young Tamarisk. Weather calm and sunny. Alt. 450 m.

The principal published list of the Odonata of the Western Mediterranean countries in Africa is still that of O. LE ROI (1915). This has proved indispensable as it covers all the literature on the subject up to that time. I have consulted many of these earlier records and where necessary checked them against specimens still available in museum collections. The present communication has been made up-to-date as much as possible by incorporating all later records that came into notice, several references being verified and identifications confirmed or corrected. It comprises unstudied material in the Institut royal des Sciences Naturelles at Brussels (IRSN), in the collections of the Zoölogisch Museum at Amsterdam (MA), and the Rijksmuseum van Natuurlijke Historie at Leiden (ML); also collections made in Spain by the late Father LONGINOS NAVÁS and others, and in Morocco by Messrs. A. BALL and L. D. BRONGERSMA. Records from Algeria and other adjacent countries in the Mediterranean have been included only where necessary or considered of interest in comparison with the regional forms. Examples of this kind are a number of old types and syntypes described by E. DE SELYS LONGCHAMPS in P. H. LUCAS's work « Exploration de l'Algérie » (1849), still in the Brussels Museum, as well as others from Algeria collected by M. QUEDENFELDT and treated by H. J. KOLBE (1884 and 1885) in the Zoologisches Museum at Berlin (ZMB). I have been enabled also to re-examine paratypes of *Cordulegaster algiricus* MORTON, deposited in the Royal Scottish Museum at Edinburgh (RSM).

Until recently, 42 species of Odonata had been recorded from Morocco, and 23 of these could be recovered during our last trip; besides, the following 8 can now be added to the regional fauna, making a total of 50 species presently known from the country. The additions are : *Calopteryx exul*, *Coenagrion mercuriale*, *Libellula quadrimaculata* (new to Africa!), *Trithemis kirbyi ardens*, *Oxygastra curtisi* (new to Africa!), *Paragomphus genei*, *Onychogomphus costae* and *O. forcipatus unguiculatus*. The larval exuviae were found of the following species : *Libellula quadrimaculata*, *Gomphus spec.*, *Paragomphus genei*, *Onychogomphus costae* and *O. uncatius*, and *Cordulegaster princeps*.

Although the list here offered may include all the species known certainly to occur in Morocco, it will be evident that our knowledge is still far from complete. It should be borne in mind that most visits to good localities, including our own, have been cursory and that extensive areas of the country are still unexplored by odonatologists. It would therefore not be surprising if a dozen or so species could ultimately be added to the 50 already known to occur. In spite of all this it is my hope that the student of this part of the African continent should now be able to form a rough idea of his field of study.

For those desirous of filling the gaps in our knowledge of Morocco as a whole, rather than merely duplicating researches in localities already worked, I suggest exploration of all permanent river systems in the north and north-east, which are entirely unknown. Practically no attention has yet been paid to coastal marshes and lakes, we did not even attempt to visit some of these which appeared to be fairly easy of access. From Agadir as a centre the Anti Atlas might be explored; and towards the east there is probably much to be added to our list in the Tafilalet area, south of Ksar-es-Souk. But even the more accessible parts of the Moyen Atlas still contain much unworked ground: the few additional species obtained at the eutrophic lake Daiet Aaoua (Loc. 3) bear witness of a highly interesting and varied fauna of which at least some components may occur also on other marshy lakes in this area. For those interested in the ecology and biology of the Odonata the hill station of Ifrane (Loc. 4), with its luxuriant forests and abundance of streams in close vicinity, is equally attractive and affords an excellent field for studying the behaviour and life history of dragonflies.

#### COMPOSITION AND DISTRIBUTION OF THE REGIONAL FAUNA.

An analysis of the Odonate fauna of Morocco is impeded by various circumstances. On the one hand the fauna of this northwestern outpost of the African continent has been much less investigated than that of the more eastern parts of North Africa, particularly adjacent Algeria. Since more than a century this last country has been much in demand and until recently frequently worked by visiting entomologists. O. LE ROI (1915) listed 69 Algerian species, including several not yet reported from Morocco which nevertheless are almost universally distributed in the Mediterranean basin. Some of these will undoubtedly turn up there sooner or later and it would be interesting to find out whether racial differentiation would permit to distinguish between the representative forms from Algeria and Morocco. On the other hand, several of the more interesting forms reportedly occurring in Algeria stand urgently in need of renewed investigation, calling for modern treatment. Their identity is mostly based on old material, often difficult of access, which should be compared with representatives of the same species elsewhere in the Mediterranean.

In the present communication some of the problems concerning taxonomy and affinity are being broached but a number of species still need careful scrutiny. As far as our present knowledge goes, the composition of the Moroccan fauna is briefly as follows.

There are 7 species and subspecies, i.e. 14 percent of the total, which are apparently confined to northwest Africa. These are : *Calopteryx exul*, *Platycnemis subdilata*, *Coenagrion puella kocheri*, *Enallagma deserti*, *Ischnura saharensis*, *Gomphus simillimus maroccanus*, and *Cordulegaster princeps*. All of them have their nearest relatives on the European continent or are derived from species having a wide distribution in Eurasia or the Mediterranean basin.

The purely Ethiopian element of the Moroccan fauna is represented only by 6 species, most of them occurring not uncommonly throughout Africa and in a more eastward direction. This means that only 12 percent of the total can be considered as having invaded the country from the south. These are *Paragomphus genei* among the Gomphidae and *Diplacodes lefebvrei*, *Brachythemis leucosticta*, *Trithemis annulata*, *T. arteriosa* and *T. kirbyi ardens* among the Libellulidae.

Of the remaining 37 species some are wide-ranging insects of the Eurasian continent, others inhabit the greater part of Europe, while the remainder are more strictly confined to the Mediterranean region, the last category being the dominant one.

Lastly, attention may be called to the joint occurrence in North Africa and Spain (and maybe Portugal) of *Onychogomphus costae* and *Cordulegaster boltoni algericus*, both of them old elements in the fauna of these countries found nowhere else, the last-mentioned one being here recorded from Spain for the first time. From the viewpoint of the zoogeographer — and even, perhaps from that of the geophysicist — it appears of interest to know whether the little explored southern provinces of the Iberian Peninsula would not yield more examples of this kind.

#### ACKNOWLEDGEMENTS.

My best thanks are due to Dr. G. DEMOULIN and his assistants, of the Institut royal des Sciences naturelles, Brussels (IRSN) and M<sup>lle</sup> S. KELLNER-PILLAULT, of the Muséum National d'Histoire Naturelle, Paris (MP), for permitting me to carry out the comparative work involved in the preparation of this article in E. DE SELYS' and R. MARTIN's collections. As regards some Algerian Odonata, I should like to express my gratitude to Dr. K. K. GÜNTHER, of the Institut für Spezielle Zoologie und Zoologisches Museum, Berlin (ZMB), for the loan of some critical species described by H. J. KOLBE. I am much indebted also to Mr. L. R. WATERSTON, of the Royal Scottish Museum, Edinburgh (RSM), whose helpful suggestions and readiness in the loan of specimens from the K. J. MORTON collection under his charge are gratefully acknowledged.

## CALOPTERYGIDAE.

*Calopteryx exul* SELYS, 1853 (fig. 1-2).

Material. — 3 ♂ 3 ♀ (adult), Loc. 4.

Extralimital material. — 1 ♂ 1 ♀ (semiadult), with green disks bearing the number « 572 » on the reverse sides and « *Calopteryx exul* Selys » on white in SELYS's handwriting; evidently syntypes, both greatly damaged and incomplete, lacking terminalia and parts of wings (IRSN). For further specimens, see below.

An endemic species of Northwest Africa, new to the fauna of Morocco.

First recorded by E. DE SELYS from Algeria as « *C. splendens* race méridionale » in P. H. LUCAS's work (1849). Our fresh specimens correspond with the descriptions, especially the one published by E. DE SELYS & H. A. HAGEN (1854) being very full, based as it is on three males and five females from Algeria. Unfortunately, the torn couple referred to above are the only specimens that could be traced in SELYS's collection at Brussels. In the Paris Museum I have found one pair from Algeria in P. H. LUCAS's collection, still indicated as « race méridionale de la *C. Ludoviciana* »; also a good series of either sex in R. MARTIN's collection, likewise from Algeria. Although at least part of the latter are of much later date, they include toponymical individuals from Constantine, the Rummel and Bou-Mersoug. As it will be impossible to find out just which examples have served the original description, I have selected a toponymical male, still in excellent condition and labelled « *C. exul* 26 mai Bou-Mersoug », as the lectotype of *C. exul*. Little else is on record of this highly peculiar species. H. J. KOLBE (1885) refers to a few Algerian examples in the Berlin Museum collected by M. QUEDENFELDT south of Algiers while R. MACLACHLAN (1897) recorded it from the eastern province of Constantine (terr. typ.). K. J. MORTON (1905) gave Sebdo in the province of Oran as a locality. The only more interesting observation was made by R. MARTIN (1910), who wrote : « Espèce indigène, trouvée d'abord au confluent du Rummel et de Bou-Mersoug, près de Constantine, où pendant longtemps on a pensé qu'elle était localisée, mais observée depuis sur une foule de ruisseaux. Je l'ai trouvée près d'Alger, puis en nombre considérable sur le ruisseau d'El-Guerra, sur le Rummel, et sur presque tous les ruisseaux de la Province. Elle voltige en troupes nombreuses, ordinairement mêlée aux *haemorrhoidalis* et à quelques *splendens*. Les mâles et les femelles sont en nombre égal ». The last remark in particular — *C. exul* having been found in company of *C. splendens xanthostoma* (CHARP.) — is of considerable interest inasmuch as *exul* was at one time considered a subspecies of *splendens*, replacing the latter in North Africa, E. DE SELYS (1871) refers to Lambèse (Lambessa) as an Algerian locality of *C. s. xanthostoma*, while R. MARTIN reports *C. haemorrhoidalis* and *exul* to share a number of localities

in the province of Constantine, El-Guerra being mentioned as a place where all three species occurred together.

*C. exul* is chiefly characterized by its unmarked, wholly transparent almost hyaline wings. These are narrower and more pointed than in western Mediterranean *splendens*, having at the same time a more open venation. The ratios between greatest breadth and length of the hind wing are as 24.8 : 100 in the male, 24.1 : 100 in the female; in the latter the wings are distinctly more drawn out (more evenly expanded) than in the male. In all specimens the extreme postero-apical margin of the wing membrane is slightly smoky. Main longitudinal veins of antenodal portion metallic blue in male, emerald green in female.

Apart from the conspicuous yellow colour on the basal antennal segments, the mouth parts and the sides and under surface of the thorax, striking features also are the pale brownish (not black) body pubescence and the yellow-striped (often whitish pruinulent) inner faces of the femora. The ground colour of those parts of the body which in *splendens* are dusky grey or even more obscured, is bright yellow in both sexes of *exul*. This is especially evident in a dorsal view of the thoracic meso- and metatergites, only the front and hind portions of the axillaries, the metascutum and metascutellum remaining brilliant blue-green.

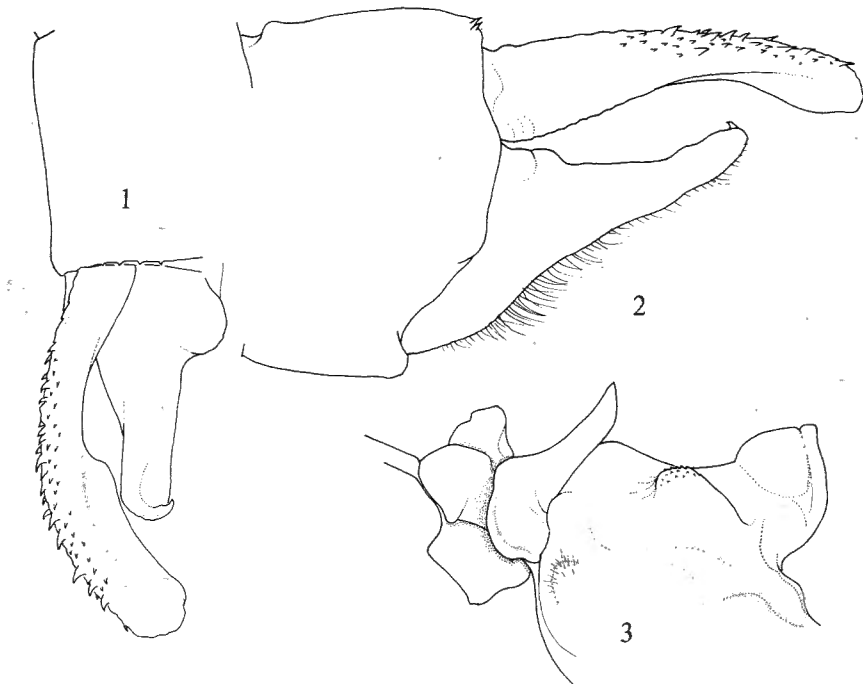


Fig. 1-2 : *Calopteryx exul* SELYS, Morocco (Loc. 4), ♂ anal appendages, partial dorsal and left lateral view. — Fig. 3 : *Platycnemis subdilata* SELYS, Morocco (Loc. 8), ♀ prothorax and lamina mesostigmalis, right lateral view.



In the male the head, thorax and abdomen above are metallic ultramarine, the thoracic sides and abdominal segments laterally emerald green. In the female the corresponding parts are throughout metallic green but on the abdomen from segm. 5 or 6 onwards gradually become less brilliant and more coppery, the terminal rings of 5-7 and the markings of 8-10 acquiring a reddish bronze tint on a pinkish buff ground.

Male anal appendages slightly slenderer on the whole than in *splendens*, superior pair a little less strongly forcipate, the inferiors somewhat narrower; armature as in *splendens* (fig. 1-2).

The pseudoptero stigma of the female is pure white, occupying four marginal cells and measuring 1.3-1.4 mm in the fore wing, 1.1-1.3 mm in the hinder pair.

Measurements: ♂ abd. + app. 39.3-41.5 mm, hind wing 30.3-32.0 mm; ♀ 37.0-38.5 and 32.0-35.5 mm, respectively.

I only took a short series of this exceedingly interesting species. It occurred in a very limited area over an exposed part of the stream where this was about four metres wide. The water was knee-deep with many submersed plants, but the banks were high and thickly covered with long grass and other lush vegetation, a biotope where one would expect *C. splendens* to occur. The species was outnumbered by *C. haemorrhoidalis*, quite inconspicuous when at rest, but once spotted easily recognized when taking wing. The site here was obviously a breeding area, males being no easy catch while flying low over the stream in pursuit of the females.

### *Calopteryx h. haemorrhoidalis* (VANDER LINDEN, 1825).

**Material.** — 1 ♂, Moyen Atlas, El Hajeb (between Meknès and Azrou), ca 1050 m, 25-V-1966, author; 8 ♂, Loc. 4; 6 ♂ 4 ♀, Loc 7; 1 ♂ 1 ♀, Loc. 8; 2 ♂, Loc 11, 1500 m, 2-VI-1966, author (ML, IRSN).

**Extralimital material (Algeria).** — 2 ♂ 3 ♀, Algeria, Tondu, Ain-Touta, det. and ex coll. R. MARTIN; 2 ♂ 3 ♀, Algeria, p. Constantine/Biskra, I-IV-, det. and ex coll. H. ALBARDA (all ML).

This western Mediterranean species has been previously recorded from Morocco (Benzus Bay) by R. MACLACHLAN (1889), Marrakech (K.J. VALLE, 1933), Ifrane and several coastal localities by P. AGUESSE & J.P. PRUJA (1958b).

The present examples all belong to a form similar to that known as typical *haemorrhoidalis* found in southern France, being absolutely inseparable from average-sized individuals collected in Corsica, Sicily and Algeria.

Size variable. Measurements (Morocco) are: ♂ abd. + app. 37.7-41.5 mm, hind wing 28.0-32.5 mm; ♀ 35.0-40.0 and 30.5-34.0 mm, respectively.

I take the opportunity of mentioning the presence in the Leiden Museum of good material available to those who might endeavour a detailed study of this polytypic species.

*C. h. haemorrhoidalis* : Cagnes (Alpes maritimes); Mugello (Appennines); near Cadiz (Sevilla) and Montilla (Andalusia) in S Spain; long series also from Menorca (Balears), Corsica, Sicily and a few from Sardinia, the species being common on all these islands. The series from Menorca struck me at the time of collecting by their smallness, averaging in fact smaller in size than all others.

*C. h. occasi* CAPRA : Environs of Genoa and Ventimiglia (terr. typ. Liguria !); good series from the Nauze, Siorac-en-Périgord (Dordogne, author leg.) and Banyuls (Pyr. Orient.), and a single male from Jacca (Aragon) in northern Spain, agreeing with paratypes from Genoa.

French specimens intermediate between the nominotype and the subspecies *occasi* are from Hyères (Var), Cagnes and vallée de Menton (Alpes Marit.); Gard and the Pyrénées Orient. Two males from Spain (ex coll. L. NAVÁS) from Rubi (Asturia?) and Tortosa (Catalonia), likewise transitional in respect of wing markings, are of rather small size.

#### LESTIDAE.

##### *Lestes barbarus* (FABRICIUS, 1798).

Reported by R. MACLACHLAN (1889) and K.J. VALLE (1933) from Esmir and Tanger. Also known from Aztou (K.J. VALLE, 1933). P. AGUESSE & J. P. PRUJA (1958a) mention Sidi Ouaddar (Morocco?) as a locality.

##### *Lestes v. virens* (CHARPENTIER, 1825).

R. MACLACHLAN (1889) gives Esmir as a regional locality for this species. There are no recent records for the country.

##### *Lestes dryas* KIRBY, 1890.

Material. — 2 ♀ (adult), Moyen Atlas, Bab-bou-Idir, 25 km SW of Taza, 1500 m, 10-VI-1961, J. DORGELO (MA).

P. AGUESSE & J. P. PRUJA (1958b) also examined a female from Bab-bou-Idir in eastern Morocco. E. SCHMIDT (1961 : 405) refers to *L. dryas* only as follows : « ... marokkanische und japanische Serien sind noch grösser ».

Our specimens are not at all larger than usual, measuring 29.0-30.0 mm for the abdomen and 25.7-28.3 mm for the hind wing.

A holarctic species becoming rarer towards the south. Also known from Spain.

*Lestes macrostigma* (EVERSMANN, 1836).

R. MARTIN (1910) writes « Observée au Maroc », but there are apparently no further records.

*Lestes v. viridis* (VANDER LINDEN, 1825).

This species was collected at Ifrane (females only), but this seems to be the only locality known in Morocco (P. AGUESSE & J.P. PRUJA, 1958b).

*Sympecma fusca* (VANDER LINDEN, 1823).

Material. — 1 ♀ (adult), Loc. 1.

Also known from Tanger (R. MACLACHLAN, 1889; and O. LE ROI, 1915).

The only specimen seen during our journey.

PLATYCNEMIDIDAE.

*Platycnemis subdilatata* SELYS, 1849 (fig. 3).

Material. — 9 ♂ (1 immature) 2 ♀ (both in cop.), Loc. 1; 2 ♂ 1 ♀ (in cop.), Loc. 6; 3 ♂ 4 ♀ (2 pairs in cop.), Loc. 8; 1 ♂, Loc. 15 (ML, IRSN). Also a short series of both sexes from Mogador (Agadir route) collected in 1934 by A. BALL (IRSN), and 1 ♂ from Oued Cherrat, 30 km S of Rabat, 18-V-1961, J. DORGELO (MA).

Previously recorded only by K.J. VALLE (1933), from Marrakech.

The literature on the taxonomy of *P. subdilatata* is rather meagre, although it has been repeatedly stated by various authors to be common and widespread in Algeria, whence it was first described. The fullest descriptions of the colour phases of the male and of the immature female are those given by E. SELYS & H.A. HAGEN (1850). Our Moroccan specimens compare well with an adult male and immature female in SELYS's collection, both carrying small green disks with « 572 », written on the reverse side and blue labels « subdilatata S. » in E. SELYS's writing. These are almost certainly cotypes from Algeria of P.H. LUCAS's « Exploration » (1849), the type-specimens probably being in the Paris Museum.

Though undoubtedly closely allied to *P. pennipes*, this North African representative should be regarded as specifically distinct therefrom, as it

was thought to be by most authors. R. MACLACHLAN (1897), who had a good series of *subdilatata* from Algeria, commented upon the variation of either sex, stressing the point that « there is no blue variety » of the species. Fully coloured males are, indeed, never as blue as are those of *pennipes* but my field notes on the adult in life refer to a « palest bluish white tint », which is still preserved in some of the dried individuals. The male anal appendages are a little different in the two species, as are also the pro- and meso-thoracic structures of the female (fig. 3). The best character is found in the shape of the tibiae, which in both sexes of *subdilatata* are noticeably less expanded than in *pennipes*. It is not true, however, that the tibiae of the female should not show any sign of dilatation, as has been stated by early writers.

I have not seen the type male of *P. algira*, described by H.J. KOLBE as a distinct species (cf. H.J. KOLBE, 1885), but Dr. K. GÜNTHER enabled me to examine a freshly emerged male and a somewhat less immature female (part of the abdomen missing) of H.J. KOLBE's species, from Blidah-Medeah. These are both labelled « Type », and have been returned to the Berlin Museum. The male I am unable to place but the female might well be *P. acutipennis* SELYS, the side-lobes of the posterior lobe of its prothorax being formed as in that species. In R. MARTIN's collection (MP) is a female (unfortunately lacking its legs!) carrying a blue label with « *Platycnemis algira* Kolbe Maroc » in R. MARTIN's hand, which agrees with *P. acutipennis* not only in the characteristic orange-pink colour of the abdomen and the thoracic markings, but also in the structure of its prothorax. Providing the locality to be correctly given, it would mean that *P. acutipennis* (or a very near ally of this) does occur in North Africa!

Measurements (Morocco) : ♂ abd. + app. 25.0-27.3 mm, hind wing 17.7-20.0 mm; ♀ 26.7-28.0, 20.3-21.3 mm, respectively.

#### COENAGRIONIDAE.

### *Pyrrhosoma n. nymphula* (SULZER, 1776).

Material. — 3 ♂ (adult), 3 ♀ (1 adult, isochr., 2 juv.-ad., heterochr.), Loc. 4 (ML, IRSN).

First recorded by P. AGUESSE & J.P. PRUJA (1958b) from the same locality. This seems to be the only one known in North Africa.

Common at Ifrane but not met with elsewhere.

The present specimens compare well with individuals of *nymphula* from various western European countries, there being no approach towards *P. elisabethae* SCHMIDT (1948) (1) from Kalávrta (N. Pelopon-

(1) I am indebted to Dr. E. SCHMIDT, who at one time presented me with some paratypes of *P. elisabethae*.

nesus) in Greece. Both sexes agree in having the ventral surface of the thorax predominantly yellow, corresponding with E. SCHMIDT's fig. 2f (male from Spain). However, the amount of black colour on these parts of the body is evidently subject to much variation. In several specimens collected in Holland and in a male which I took at the Charente near Chateaufrenaud (southern France), for instance, the yellow colour on the ventral surface of the thorax is even more restricted than in a male of *P. elisabethae* figured by E. SCHMIDT (loc. cit., fig. 2c). The anal appendages in our Moroccan specimens are exactly of the shape characteristic for typical *nymphula* and I have failed to discover any peculiarities as to colour or size.

K.F. BUCHHOLZ (1954) found specimens from Thessalia in Greece to be rather intermediate in certain respects between *nymphula* and *elisabethae* and inclines to regard the latter only subspecifically distinct from *nymphula*. In this connection it may be of interest to mention that a series of both sexes in the Leiden Museum collected in Macedonia (Bitola, VI-1958, J. LEINFEST) and in Montenegro (Bijelepolje, VI-1960, P.R. DEELEMANN-REINHOLD) are quite similar in every respect to western populations of *P. nymphula*.

Measurements (Morocco) : ♂ abd. + app. 28.7-30.2 mm, hind wing 22.8-24.0 mm; ♀ 28.0-29.3 and 23.8-25.5 mm, respectively. P. AGUESSE & PRUJA (loc. cit.) give : ♂ 28-29 and 22-23 mm; ♀ 27-28 and 24-24.5 mm.

### *Ceriagrion tenellum* (DE VILLERS, 1789).

I have found only two records for this species in Morocco : Esmir (R. MACLACHLAN, 1889) and Tanger (O. LE ROI, 1915).

### *Coenagrion c. caerulescens* (FONSCOLOMBE, 1838).

Material. — 7 ♂, Loc. 4; 2 ♂ 1 ♀, Loc. 6; 3 ♂ 1 ♀, Loc. 8; 6 ♂ 3 ♀, Loc. 10 (ML, IRSN).

First recorded from Morocco (Ras-el-Ma) by K.J. VALLE (1933) and subsequently by P. AGUESSE & J.P. PRUJA (1958b) from the same locality and Ifrane.

This western mediterranean species has recently been revised by E. SCHMIDT (1959) in a profusely illustrated publication. His analysis, which also contains tables of body measurements, is based on a rich material from all over the known range of this variable insect. It includes 8 males and 4 females from Morocco. In the Leiden Museum the species is equally well represented by specimens from various localities and I have therefore taken the present opportunity to supply notes on all specimens at present available.

As so-called « Ersatz-Typen » of *caerulescens* SCHMIDT selected 5 ♂ and 3 ♀ ex coll. FONSCOLOMBE (in the Brussels Museum), which therefore

should be taken as the lectotype series. Probably all of these are from the vicinity of Aix-en-Provence, the original locality. E. SCHMIDT recognizes two subspecies of *caerulescens*, one from Italy and Sicily (*caesarum* SCHMIDT) and a second from North Africa (*theryi* SCHMIDT), the type of the latter being from Algeria.

The abdominal patterns and sizes of our specimens were carefully compared with the data embodied in E. SCHMIDT's account, with the following results.

Male. — All Moroccan specimens (18 ♂ 5 ♀) have the black marks on abdominal segments 1-3 as in E. SCHMIDT's fig. 3C-D (Spain and Brindisi) and the type series from southern France. The markings at the terminal segments are very variable within our series, quite independent from locality: 7 ♂ correspond with E. SCHMIDT's fig. 4k, 1 and m (Alge-

Locality	Number ♂	♂					
		Abd. + app.			Hind wing		
		Max.	Min.	Aver.	Max.	Min.	Aver.
Loc. 4 (1650 m)	7	23.7	21.2	22.56	17.5	15.3	16.3
Loc. 6 (1000 m)	2	23.5	22.5	23.0	16.5	16.5	16.5
Loc. 8 (1500 m)	3	24.0	20.3	22.7	18.0	15.0	16.5
Loc. 10 (1150 m)	6	23.5	21.0	22.3	18.0	15.0	16.43
Morocco, total average		22.64			16.43		

Locality	Number ♀	♀					
		Abd. + app.			Hind wing		
		Max.	Min.	Aver.	Max.	Min.	Aver.
Loc. 4 (1650 m)	—	—	—	—	—	—	—
Loc. 6 (1000 m)	1	—	—	23.4	—	—	18.7
Loc. 8 (1500 m)	1	—	—	21.2	—	—	16.3
Loc. 10 (1150 m)	3	25.0	22.7	23.6	19.0	17.0	18.0
Morocco, total average		22.7			17.7		

ria), 4 ♂ with fig. 4f and g (Spain), 5 ♂ with fig. 4i (also from Spain), and 1 ♂ with fig. 4d (Brindisi). The measurements are given in the table.

**F e m a l e .** — The terminal abdominal segments of 2 ♀ are marked as in fig. 5U (Algeria), 2 ♀ as in fig. 5W/X and Y (Tuscany and Brindisi) and 1 ♀ as in fig. 5V (Spain). The first two are exactly similar in this respect to 3 ♀ in the Leiden Museum from southern France (Digne and « Provence »), agreeing with the latter also in size.

When consulting E. SCHMIDT's figures of the abdominal marks it is to be noted that not one of our Moroccan males corresponds with his darkest extreme (fig. 40) from the same country, and also that our females agree with the figures he gives of those from south Italy, not with E. SCHMIDT's Algerian and Spanish examples (fig. 5). In E. SCHMIDT's key (loc. cit. : 9) the males run to either typical *caerulescens* or his race *theryi*, while the females key out to the race *caesarum*. I have for comparison 1 ♀ from « Provence » (ex. coll. E. SELYS), 4 ♂ 3 ♀ from Digne (Basses Alpes, ex coll. K. J. MORTON), 4 ♂ 1 ♀ from Spain (ex coll. L. NAVÁS), 5 ♂ from Menorca (Balears, collected by myself), 4 ♂ 1 ♀ from Tripolitania (ex coll. C. NIELSEN), 4 ♂ 2 ♀ from the environs of Rome (Lazio, Italy, ex coll. CONSIGLIO), and 1 ♂ 1 ♀ from Sardinia (ex coll. E. SELYS, in coll. H. ALBARDA). It is interesting to note that of the Spanish material, presented to me long ago by Father L. NAVÁS, only one pair (Granada, VIII-1920) was identified by L. NAVÁS as *caerulescens*, 2 smaller ♂ (Tarragona, Tivisa, VII-1922) being named *scitulum*, and 1 ♂ of large size (Montasso, VI-1923) carrying his label *mercuriale*! All are, however, *caerulescens*; they differ much in size but otherwise show all intergradations in the extent of dark abdominal markings. The same applies to the specimens from southern France and Menorca. As to our small series from Italy, it must be admitted that these not only average larger in size (♂ abd. + app. 24.5-25.0, hind wing 17.0-19.0; ♀ 24.0-25.0 and 20.0-21.0 mm) but differ also from the rest in that the black marks of the basal and apical abdominal segments are definitely more restricted, shaped similarly to E. SCHMIDT's figures 3A-B and 3a-c for the ♂ and 5X for the ♀ (all from Italy).

It will be evident from the above that it is altogether impossible to distinguish the North African populations from those of south-western Europe and that *theryi* is undefinable as a subspecies. The name *caesarum* SCHMIDT, however, may stand to designate a subspecies from Italy (and Sicily?)

### Coenagrion m. mercuriale (CHARPENTIER, 1840).

**M a t e r i a l .** — 3 ♂, Loc. 4; 3 ♂, Loc. 5; 3 ♂, Loc. 10; 1 ♂, loc. 11, 2-VI, 1500 m. (ML, IRSN).

**E x t r a l i m i t a l m a t e r i a l .** — 2 ♂ 2 ♀ (♀ defective), labelled « Alg. Lamb. [= Lambessa] Eth. » and « Sichel » (blue) under

drawer label *A. hermeticum* SELYS : probably types of *A. hermeticum* (IRSN).

Apparently not previously reported from Morocco but known from several localities in Algeria.

I am quite unable to recognize a distinct North African subspecies of *mercuriale*, a variety that was given the name of *hermeticum* SELYS (1872 : 45), proposed to denote two aberrant males from Algeria. In the Synopsis (1876 : 1277), however, its validity was called in question by the same author. Only two individuals in our Moroccan series (one each from Asni and Timhadite) approach this form by showing a tendency toward a broadening of the black marks on segm. 2-3 of the abdomen, in one the blue ground colour of the dorsum of 2 being much restricted and in the form of two oval spots placed at the base of the segment. Otherwise even this specimen is quite normal, falling well within the well known range of colour variation, so often commented upon in the literature on this species. As to the extent of the blue colour (postocular spots and terminal abdominal markings included), all intergradations occur, the lightest extreme being found among the males from Ifrane, one having the black spot on segm. 2 deeply twice indented with the side arms finely tapered, in contrast with the two others in which this spot is much stouter with arms attached to the base of segment. Our specimens also differ much in size : two males taken simultaneously (Loc. 10) measure 21.0 and 25.2 mm for the abdomen, 16.0 and 18.0 mm for the hind wing ! The former are of the same small size as SELYS's males of *hermeticum* from Algeria.

At Ifrane and Asni the species occurred together with *C. caerulea*, the latter in both localities being the commonest of the two.

In the Berlin Museum is a female labelled « Algerien, zw. Blidah u. Medeah, 6.-8.84, M. Quedenfeldt » and bearing a second label « Agrion mercuriale Charp. subsp. det. Dr. Er. Schmidt 1937 ». This specimen, which also has a red pin-label « Type », may or may not be the supposed female of *Ischnura lamellata* KOLBE, 1885. It tallies H. J. KOLBE's description but there is no trace of a vulvar spine and the specimen does not differ from typical examples of *C. mercuriale* (CHARP.).

### *Coenagrion puella kocheri* (SCHMIDT, 1960).

**Material.** — 2 ♂, Loc. 1; 5 ♂ 1 ♀, Loc. 3; 2 ♂, Loc. 4. (ML, IRSN). Also 1 ♀, Moyen Atlas, Azrou, 6-12-VII-1934, A. BALL, labelled « *A. puella* Theryi Schmidt in litt. » (IRSN).

This subspecies of the common European *C. puella* was first recorded from Morocco by P. AGUESSE & J.P. PRUJA (1958b) who had two males from Ifrane which they referred to *C. syriacum* (MORTON, 1924). Further material from the whole Mediterranean region enabled E. SCHMIDT (1960) to form a clearer idea of the character of *C. puella* in this highly variable genus. E. SCHMIDT pointed out that *Agrion puella syriaca* MORTON should



be given full specific rank and that the name must be applied to the populations of « *puella* » occurring in Asia Minor, the Caucasus, Syria and several of the adjoining countries in the Near East. The North African representative of *C. puella* (from Algeria and Morocco), as also a similar form occurring in Crete, were considered by E. SCHMIDT as a subspecies of *puella* which he named *kocheri*, n. subsp. For full references see his paper.

The following notes are based on the small series recently collected.

Structurally, both sexes of *C. p. kocheri* are indistinguishable from nominotypical *puella*. The male differs from the latter only in that the dorsum of the 8th abdominal segment is marked with a pair of black longitudinal spots, one on either side of the middle, on the posterior portion of the segment. These spots are invariably present but vary much in size, being either completely isolated or fused together apically (for figures, see P. AGUESSE & J.P. PRUJA, loc. cit. : 12). As to the female, it is of interest to note that E. SCHMIDT found 18 out of 31 Moroccan examples to resemble the common variety of *pulchellum*, i.e. the form with restricted black abdominal bands (form b of E. SCHMIDT). However, the same author points out that an even greater percentage of this light-coloured variety is represented in a series of « typical » *puella* he possesses from Greece (31 out of a total of 34); on the other hand 18 females from NE Spain exhibited the normal colour pattern. Hence it is evident that this feature, no more than in *pulchellum*, can be used as a criterion for racial differentiation.

The two examples of Loc. 1, from near the westcoast, are toptotypical, whereas the others are from a much higher altitude in the interior. When I took my first specimens at the typical locality I was struck by their small size, one especially being exceptionally small (see below). Those from the mountains are on an average larger but it must be said that only 7 were collected and measured. This more or less corresponds with the results obtained by E. SCHMIDT, who measured 29 males of Loc. 1 and found average sizes of 24.6 mm for the abdomen, 17.3 mm for the hind wing. Of 10 males from Loc. 4 the corresponding averages were 26.8 mm and 19.5 mm, respectively.

**F e m a l e .** — The only example seen and captured belongs to the form b of E. SCHMIDT (1960), a variety in which the bronze-black markings on the abdomen are reduced and shaped similarly to the corresponding (and much more common) variety of *C. pulchellum* (VANDERL.). The abdominal pattern agrees with E. SCHMIDT's fig. 24e in his 1929 work (Tierw. Mitteleuropas) except that the dark marks on segm. 2-7 occupy a little less of the surface, the spot on segm. 8 being, however, broadly attached to the apical margin. This somewhat rare variety has been found also in several European countries (a.o. in England, Belgium, Holland and Germany); it is known under a manuscript name « var. ♀ *annulatum* », once given to it on a label by E. DE SELYS LONGCHAMPS (see M.A. LIEFTINCK, 1925, Odon. Neerl. 1 : 170).

The only conclusion that can be drawn from the above is that *C. puella*, although being relatively of small size in Morocco, exhibits the same amount of variation in this respect as it does in any other country provided that good series from one locality are available. The name *C. p. kocheri* can be applied to a poorly defined subspecies of which the male has black spots on the 8th abdominal segment.

Measurements: ♂ abd. + app. 22.52-24.2 mm, hind wing 15.8-16.8 mm (Loc. 1); 25.6-27.0 and 19.0-20.0 mm (Loc. 3); 26.5-27.3 and 20.0-20.2 mm (Loc. 4); ♀ 25.3 and 20.0 mm, respectively.

Note. — ST. QUENTIN (1965) states that *C. puella kocheri* differs from the nominate by having « längere Appendices der ♂ ♂ ». This does not, however, apply to typical *kocheri* from Morocco.

### *Coenagrion scitulum* (RAMBUR, 1842).

Material. — 3 ♂ 1 ♀, Loc. 1; 3 ♂ 1 ♀, Loc. 3 (ML, IRSN). 1 ♂, Moyen Atlas, Ifrane, 1700 m, 26-V-1961, J. DORGELO (MA).

Previously known only from a female taken at Ito (Moyen Atlas), recorded by P. AGUESSE & J.P. PRUJA (1958a).

Some variation exists in the extent of the black dorsal marks on the abdomen of the male, the spot on 3 occupying from a little less to slightly over half the length of segment; this spot is either indented by blue, squarely cut off, or even somewhat narrowed and rounded anteriorly. The black on segm. 9 may be in the form of a broadly sessile U-shaped terminal mark, a pair of irregular longitudinal streaks, or absent altogether.

Size variable. Measurements are: ♂ abd. + app. 22.6-24.5, hind wing 16.2-18.0 mm; ♀ 22.5-22.7 and 17.5-18.0 mm, respectively.

### *Cercion l. lindeni* (SELYS, 1840).

Material. — 6 ♂, Loc. 1; 8 ♂ 1 ♀, Loc. 3; 1 ♀, Loc. 4 (ML, IRSN).

Previously recorded from Tanger by R. MACLACHLAN (1889), from montane habitats in the Moyen Atlas (Ito, Aguelmane Azigza and Ifrane) and from Marrakech by P. AGUESSE & J.P. PRUJA (1958a and 1958b).

All specimens are fully coloured. There is nothing by which they can be distinguished from western European *lindeni*. Several males are as heavily marked as certain individuals from Belgium, Holland, southern France and Italy, with which they were compared. The extent of the arrow-shaped spots on the intermediate segments of the abdomen, and the amount of blue on the tenth segment as well, varies between individuals from either locality in our Moroccan series. A heavily marked male from A. Azigza (Moyen Atlas) was figured by P. AGUESSE & J.P. PRUJA (loc. cit.), who compared it with a lighter coloured specimen from southern France.

In the Leiden Museum is a male from Philippeville (A. THÉRY) and one pair labelled « Constantine( Lambèse IV/13 » (ex coll. E. SELYS, in H. ALBARDA's collection). These Algerian specimens also differ somewhat among themselves.

### *Enallagma deserti* (SELYS, 1871) (fig. 5).

**Material.** — 7 ♂ (adult), Loc. 3 (ML, IRSN).

**Extralimital material.** — 1 ♀ (adult, holotype), labelled on white «Alg. Lamb. [Lambessa] Eth.», « Sichel » (written on dark green), and « *Enallagma deserti* Selys ♀ Holotypus » det. Dr. E. SCHMIDT 1937 (IRSN). 1 ♂ (adult), labelled « Algérie, p. Constantine 26/3 Biskra », and « *Enallagma cyathigerum* Charp. ♂, both in H. ALBARDA's writing, ex coll. H. ALBARDA (ML).

This is a much discussed and still somewhat puzzling species. It may have been wrongly interpreted by some authors and, with the fresh material on hand, calls for a renewed investigation.

The type from Algeria, now before me, is a fully adult specimen which has evidently been preserved in some liquid before it was mounted. The wing membrane is of an unusually semitransparent milky tint, the venation including the pterostigma being throughout pale brownish yellow. The ground colour of the head, thorax and legs is light buff, the abdominal segments gradually acquiring a pale yellowish glaucous tint, much as in immature females of *cyathigerum*. What makes the insect look different from that species are the bronze black markings, which on all parts of the body show extreme reduction, more so in fact than in any light-coloured *cyathigerum* which I have seen, although these markings in form and arrangement are absolutely similar to that species. For further details, see the original description.

The first male associated with *deserti* was the one described by F. RIS (1928), which also shows extreme reduction of dark markings. However, this example in all probability is an aberrant individual, as is evident from the description of the 6th and 7th abdominal segments, of which F. RIS writes : « 6 schwarz etwa das hintere Drittel mit einer vordern Spitze, bis zur Mitte. 7 schmaler terminaler schwarzer Ring, dann blauer Ring von etwa einem Fünftel der Segmentlänge, schwarzer Ring von etwa einem Sechstel dieser Länge, der nach vorne in eine schmale Spitze bis zum vordern Drittel der Länge ausläuft. » Indeed, a very aberrant pattern for *Enallagma* !

With only the above two descriptions available in the literature, it is hardly surprising to find *E. deserti* wrongly interpreted by later authors. In the notes that follow I have summarized all additional knowledge concerning what may be called the « *E. deserti* problem ». Admittedly, a re-examination of all forms allied to *E. cyathigerum* will be necessary, and

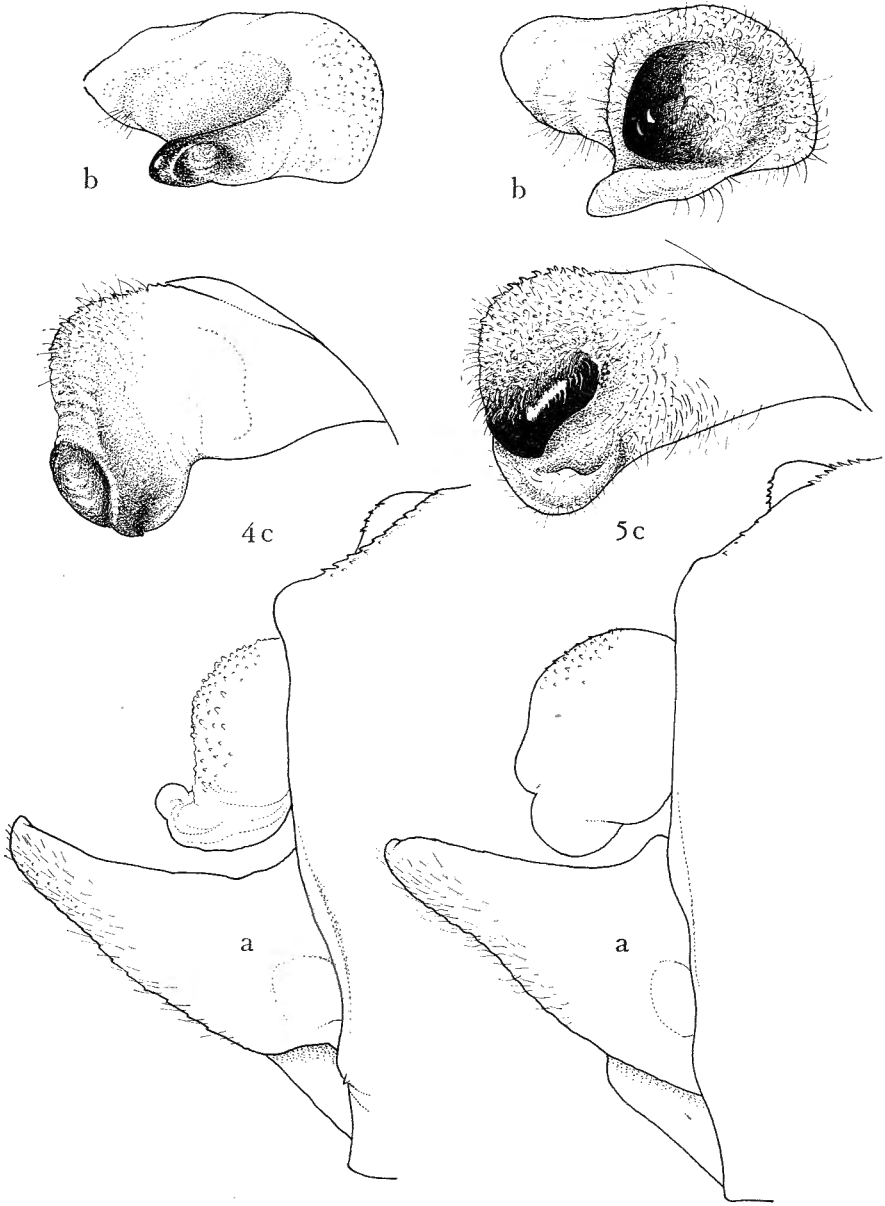


Fig. 4a-c: *Enallagma cyathigerum* (CHARP.), from Germany (Eifel), ♂ anal appendages. — Fig. 5a-c: *E. deserti* SELYS, from Morocco (Loc. 3), ♂ anal appendages. a, right lateral view; b, caudal view of right sup. app.; c, oblique interior view of left sup. app. Pubescence of sup. app. in fig. 4a and 5a omitted. All figures same magnification.

the discovery of more *deserti* in Algeria must be awaited before any solution can be given.

P. AGUESSE & J.P. PRUJA (1958b), who supplied sketches of the colour design as well as of the penis of the male, examined three specimens from Morocco (Aguelmane Aberhane and Ifrane), all of these apparently lacking their terminalia. They were referred to *E. deserti* (SELYS) « sans aucun doute ». The present material leads me to comment, first of all, that there is nothing in my recollection or notes to show that the Moroccan *Enallagma* on the day they were captured differed in any way from *cyathigerum*, a species which I had seen alive only a few weeks earlier in Holland. A brief description of these follows.

**Male (Morocco).** — No trace of blue on dorsal surface of head posterior to the antennal sockets. Postocular spots of normal size, pear-shaped, outline either entire, irregularly undulated or even slightly denticulate, completely and rather broadly surrounded by black and not nearly confluent with the blue line bordering occipital crest; rear of the head for the greater part blue. Colour pattern of prothorax, synthorax and abdomen exactly similar to typical *cyathigerum*; blue line at middorsal carina of mesothorax variable, in 4 specimens reduced to a short streak at lower end. Black stripe bordering humeral suture also slightly varying in width. Outer faces of all femora black. Wings hyaline; main longitudinal veins either definitely yellowish, especially the anterior nervures, or brown and not at all differing in colour from ordinary *cyathigerum*. Pterostigma dark grey to black, finely surrounded with yellow. Black mark on dorsum of segm. 2 of abdomen as in *cyathigerum*, in 3 males detached from the black apical annule; marking on succeeding segments 3-7 and 10 slightly variable in length and shape, exactly as in *cyathigerum*.

Anal appendages not differing in colour from those of *cyathigerum* but superior pair shaped much as described by F. RIS (1928) for his *deserti* and as shown in fig. 5. For comparison with the former species, I have drawn the appendages of a western European *cyathigerum* (fig. 4), to which purpose a male from West Germany (Eifel, Mosenberger Maar, near Manderscheid, 500 m, 28-IX-1964, author) was selected.

**Male (Algeria).** — Colour design agreeing in almost every respect with that of the above specimens from Morocco, at the same time differing very markedly from F. RIS's description (loc. cit.) of his example of *deserti* from Saida (prov. of Oran). The dorsal surface of the head is all black, the blue postocular spots being isolated and of moderate size. The median crest of the thorax bears an almost complete blue line, widest ventrally, while the black humeral stripe is rather narrower than in 6 out of the 7 Moroccan males. Main longitudinal veins definitely yellow, especially those of the costal and antenodal portions of the wings; these veins are, however, scarcely paler than in some Moroccan specimens. Pterostigma shaped and coloured similarly. Abdominal markings (including those on segm. 6 and 7) as in normal *cyathigerum*. Anal appendages

shaped and coloured exactly as shown for one of the males from Morocco. Only the abdomen of this Algerian example is markedly longer, measuring 28.0 mm; hind wing 21.7 mm.

Measurements : ♂ abd. + app. 25.1-26.3 mm, hind wing 20.2-21.2 mm.

With no knowledge of the type and of F. RIS's male from Algeria, one would not hesitate to place the above examples as a subspecies of *E. cyathigerum*. Colour differences between the males are quite unapparent while the feature of the light venation of some *deserti* appears to be equally unimportant. (2) However, there still remains the slight though well-marked and constant difference found in the male superior appendage. This part is shaped exactly as in the Algerian male also before me; and unless there are two closely allied species in North Africa, which is unlikely, the question arises whether *E. deserti* has developed two subspecies, one in some parts of Algeria (typical *deserti*) and one of more normal appearance occurring in Morocco and other regions of Algeria. Of the latter most unfortunately we have no females for comparison with the holotype of *deserti*.

The occurrence in the Nearctic Region of a number of intimately allied species of the *E. cyathigerum* group, suggests a similar situation to exist in Eurasia. A very full account of Canadian *E. cyathigerum* and its nearest relative *E. boreale* SELYS (terr. typ. : White Bay, Terre-Neuve, now in the Brit. Mus.) is to be found in E.M. WALKER's (1953) monograph. It contains many excellent illustrations of adult as well as larval structures.

Old World members of the group requiring further study are the following.

A.N. BARTENEF (1929) described *E. cyathigerum* var. *rotundatum* nov., from Lake Atshischgho (Caucasian coast of the Black Sea). The male is said to differ from typical *cyathigerum* by entirely lacking any projection at the posteroventral part of the superior appendage, the latter in profile appearing as a small bluntly rounded tubercle, shorter than and very different in shape from the one figured here for the North African *E. deserti*. The female of A.N. BARTENEF's insect is stated not to differ from the typical form. A.N. BARTENEF also remarks that all examples of *cyathigerum* he has seen from other localities in Transcaucasia are true to the type. The data and poor figure he gives of *rotundatum* would suggest a distinct species.

(2) In the Leiden Museum is a male *E. cyathigerum* collected in southern Jugoslavia by members of the staff, on the eastern shore of Prespa Lake, about 120 km S of Skopje, 15-VI-1965. This has so many features in common with what has been written about « *deserti* auct. », that it could be easily mistaken for it. The anal appendages show it to be a true *cyathigerum* but the wing veins are conspicuously yellow, at least as pale as in the male from Oran and distinctly lighter than in the Moroccan series. The postocular spots are larger and the black humeral stripe narrower than in all these; the spot on abdominal segment 2 is detached from the apical margin. Size large : abd. + app. 27.0 mm, hind wing 22.0 mm. Specimens of *cyathigerum* similar to the last will undoubtedly be found in other countries.

S. ASAHINA (1949) described *E. yezoensis* nov., from Hokkaido (N. Japan), as a new subspecies of *deserti* SELYS. It is unbelievable that a subspecies of our African *deserti* should occur in Japan. I rather suspect *E. yezoensis* to be a very near ally of the Nearctic *E. boreale*, if the two are not identical. In his later papers S. ASAHINA refers to an earlier described Japanese species, viz. *E. circulatum* SELYS, 1883, as constituting a second subspecies of *deserti* occurring in Japan. It must be pointed out, however, that *circulatum* is rather an enigmatic insect, which is described as having dark lateral bands on the abdomen. The species is not represented in E. SELYS's collection and may not even be congeneric; the type (ex coll. R. MACLACHLAN) should be in the British Museum (Nat. Hist.).

E. SCHMIDT (1961) described *E. risi*, as a new species from Afghanistan. This he refers to the same form as the one from Central Asia and Turkestan, defined (but left unnamed) by F. RIS (1928). In the H.A. ALBARDA collection (ML) are two males from Turkestan, named *cyathigerum*, which on the basis of their appendages I am inclined to place here. At any rate these are so similar in every other respect to *cyathigerum* that I do not hesitate to place them in the same species group.

D. ST. QUENTIN (1962) described *E. strouhali* nov., after a male and female from Charbin (Manchuria). This is obviously distinct from *E. boreale* SELYS, 1875. A male in the Stockholm Museum, still before me, from SW. Mongolia, 5-VIII-1931, SÖDERBOM, is undoubtedly conspecific. It agrees in all respects with the description and figures; to these may be added that the tip of the « scharfen Hacken » at the upper branch of the superior appendage is smooth and polished, as it is in *E. deserti*.

Besides the above, there are two more Asiatic species of *Enallagma* requiring elucidation, viz. *E. melanotum* SELYS, 1876 (China) and *E. ambiguum* L. NAVÁS, 1936 (Kuling, China). In E. SELYS's collection (IRSN) are two males of *E. melanotum* bearing identification labels of Dr. S. ASAHINA, who labelled them as « Coenagrion ? sexlineatum Selys ». Lastly, *E. ambiguum* is said by L. NAVÁS to come nearest *melanotum*, although the author admits that the latter has remained unknown to him.

Summarizing the above, it may be worth stressing the necessity of comparing anew the structural characters of all Old World forms of the *E. cyathigerum* group in order to establish their true relationship. The discovery in the submontane areas of Morocco of what has been considered a true desert species is remarkable. Little is known on the subject of variation in colour in connection with the different aquatic and terrestrial conditions in which the larvae and imagines live. The occurrence of a light-coloured form of *Enallagma* (genuine *deserti*) in the Algerian Sahara and a darker form in the Moyen Atlas, would seem to indicate that the latter is a subspecies that has successfully established itself in mountains, which are not truly desert in character but adjoin real desert.

It goes without saying that I cannot agree with D. ST. QUENTIN's (1965) opinion, set forth in his account of the « Randformverbreitung »

in Odonata, that *E. cyathigerum* should be an example in support of this hypothesis.

### *Ischnura graellsii* (RAMBUR, 1842).

**Material.** — 2 ♂ 1 ♀ (isochrom.), Loc. 1; 11 ♂ 6 ♀ (5 isochrom., 1 heterochrom., orange), Loc. 3; 2 ♂, Loc. 4; 2 ♂, Loc. 5; 1 ♂, Loc. 9; 2 ♂ 1 ♀ (isochrom.), Loc. 10 (ML, IRSN). Also 1 ♀ (isochrom.), Moyen Atlas, 32 km S of Azrou, 2000 m, 25-VIII-1964, L. D. BRONGERSMA (ML). Also 3 ♂ 2 ♀, Moyen Atlas, Meknès, 3-VII-1934, A. BALL (IRSN).

Evidently the commonest *Ischnura* in Morocco, recorded previously from Casablanca (sub *I. maroccana* KOLBE) by H. J. KOLBE (1887), from Esmir and Tanger by R. MACLACHLAN (1889), and from « Maroc jusqu'au Moyen Atlas » by P. AGUESSE & J.P. PRUJA (1958b). This last statement now needs alteration as our series was taken much farther south, well within the Haut Atlas mountains.

The male of this species is easily distinguished from *I. genei* by the slenderly curved, uncrossed and diverging inner branches of the superior anal appendages. These branches are longer than in *I. elegans*, from which *graellsii* also differs by the shape of the posterior lobe of the prothorax. I have confronted our Moroccan series with specimens from Spain and found them well agreeing.

### *Ischnura pumilio* (CHARPENTIER, 1825).

**Material.** — 1 ♀ (heterochrom., var. *aurantiaca* SELYS), Loc. 3; 1 ♂, Loc. 6; 5 ♂, Loc. 10 (ML, IRSN). Also 1 ♂, Moyen Atlas, 32 km S of Azrou, 2000 m, 25-VIII-1964, L. D. BRONGERSMA (ML), and 1 ♂ 1 ♀ (in cop.), Moyen Atlas, Ifrane, 1700 m, 7-VI-1961, J. DORGELO (MA).

An easily recognized species, locally not uncommon in the well-irrigated Reraia valley and probably occurring elsewhere in all suitable places. *I. pumilio* frequents still water and it was exactly in the abandoned marshy spots that several males were taken. Hitherto only a single female of the var. *aurantiaca*, collected at Ifrane, had been recorded from the country (P. AGUESSE & J.P. PRUJA, 1958b).

### *Ischnura saharensis* (AGUESSE, 1958), new status.

**Material.** — 1 ♂ 1 ♀ (adult), Loc. 14.

**Extralimital material.** — 6 ♂ 2 ♀ (adult), Algeria, Massifs du Hoggar, Tamanrasset, 1400 m, 17-VII-1935, ex coll. C. NIELSEN and D. ST. QUENTIN, all identified with *I. graellsii* (RAMB.) (ML). 1 ♂ 6 ♀, Sahara algérien, Laghouat, Ain Rich, Temaain and Biskra, IV-VI-1908, A. LAMEERE (IRSN).



This interesting species was first described and figured from North Africa by P. AGUESSE & J.P. PRUJA (1958b) as a doubtful species belonging to the group of *I. elegans* (VANDER LIND.). Shortly afterwards P. AGUESSE (1958) recognized it as new, classifying the insect as a subspecies of *I. elegans*. In the same publication several other specimens from outside Morocco, treated as *graellsii* by some authors and including also the *Ischnura* spec. which K.J. MORTON (1905) had recorded from Biskra in Algeria, were likewise transferred to *saharensis*. The type is a male from Taghit, south of Colomb-Béchar, Algerian Sahara (Mus. Paris). This is undoubtedly also the *I. graellsii* (?) recorded from the Algerian Sahara, queried by F. RIS (1913).

As stated in the original description, *I. saharensis* has the general aspect of *I. elegans* (VANDER LIND.), *genei* (RAMB.) and *graellsii* (RAMB.). Although figures of the male appendages in caudal aspect, the penis, and the prothoracic hind lobe of both sexes, were supplied by P. AGUESSE, the author has not, in my opinion, sufficiently utilised these features for comparison with those of related species. P. AGUESSE evidently considered the above structures of too little importance to employ as specific characters and therefore turned to examine the insect's penis, « une pièce rarement utilisée par les Odonatologues » (!). Encouraged by a statement of Prof. R. JEANNEL (« le pénis prime tout »), he carefully studied the apical segment of this organ, comparing it with that of a number of other Mediterranean *Ischnura*, i.e. *elegans*, *genei*, *graellsii*, *senegalensis*, *pumilio* and *fountainei*. Between *pumilio*, *senegalensis* and *fountainei* well-marked differences were observed by him in the proportionate lengths of the basal and distal parts as well as in the relative size of the sclerotized ventral spines at that segment. He therefore opines that the last three should be considered « bonae species », a conclusion already arrived at long before on the basis of other characters. Of the remaining species, P. AGUESSE also found *I. graellsii* to stand somewhat apart from the others in this respect, thus making allowance for another full species. Up to this point P. AGUESSE's investigation harmonizes with the current interpretation of these taxa, his finds being in accordance with other recognized specific features. However, the author goes further and, seeing that the penis structure of *genei* and *saharensis* resembled that of *elegans* fairly closely, jumps to the conclusion that *genei* and *saharensis* should be considered subspecies of *elegans*, a course which I am unable to follow. Interspecific resemblances between penes do not necessarily reflect close affinity between the species involved; nor the reverse, for even in closely interrelated species the penes may show slight but constant differences. It should be emphasized that to establish relationships the structure of this organ should be used with caution and always taken in conjunction with other less delicately built morphological parts of the body. In *Ischnura* the shape of the male and female prothoracic lobes and male anal abdominal appendages are highly characteristic, more stable in detail of structure and therefore more reliable

as a means of distinguishing between the various members of the genus. With regard to *I. genei*, I am not at all convinced that this is only racially distinct from *elegans*. F. CAPRA (1963a) inclines to follow P. AGUESSE but it should be noted that the inner branches of the superior appendages of male *elegans* and *genei* are constantly different and the same applies to the prothorax, though each of these shows a certain amount of variation in respect of the last character.

As we will see, *L. saharensis* can not be linked with any of the other species. The following additional features are taken from the couple from Ijoukak.

**Male (adult).** — Whole anterior surface of head, as far as the base of antennae, green; labrum with a continuous black stripe at base; postclypeus greenish black with slight metallic green lustre. Head above dull bronze-black; postocular spots green, of moderate size, almost circular; a transverse green stripe at occipital margin; rear lemon yellow on outer halves.

Prothorax with the entire anterior lobe and lower half of pleurae green, pronotum black. Posterior prothoracic lobe consisting of two divisions: a complete, transverse, yellow green basal crest (at times more or less divided medially so as to form two slightly converging crests), slightly elevated, curved and a little produced backward in the middle, immediately followed at a lower level by a short black lobe, rather deeply hollowed out on either side of the middle, the latter being raised in a blunt tubercle.

Mesostigmal lamina green and in the form of a simple, straight swollen ridge, widest laterally, whose outer edges are rounded. Synthorax bronze-black and green, with a pair of complete straight antehumeral stripes, widest below; sides with a short black streak at upper end of first suture and a slightly wider one, tapered down to a fine point, along upper half of second suture.

Legs yellow green; all femora heavily striped with black externally, the stripes at outer faces of tibiae narrow and obliterated.

Wings with main longitudinal veins yellow, cross-veins obscured distally. Antenodals 8 in fore wing, 6-7 in hind wing (both sexes). Pterostigma of fore and hind wings of equal size, a little less oblique than in *I. genei* or *graellsii* but coloured similarly.

Abdomen, dorsum of segm. 1 strongly raised and hairy posteriorly, as in *I. genei* and *graellsii*, but surface of 2 smooth, lacking any tuberculations upon distal half of segment; ground colour of 1-2 blue-green, of 3-6 bright ochreous, of 7-10 blue. Markings similar to those of the allied species but dorsal bands of 3-6 narrower, leaving more of the ground colour; 7 broadly black above; 8 entirely blue; 9 blue with complete broad dorsal mark, widest distally and rather constricted at extreme base; 10 with only the lower part of the sides blue. Raised portion of segm. 10 and anal appendages shaped much as in the allied species (including *elegans*) but

the former narrower and distinctly higher when looked at from behind than in typical *elegans*, with the lateral tubercles more closely approximated.

Superior anal appendages black, the inferior pair citron-yellow, only the tips of the outer branches of the latter black. Outer branches of inferior pair longer and definitely more slender than in *elegans*, their tips finely acuminate (not distinctly denticulate as in *elegans* and *genei*!).

**F e m a l e** (heterochromatic). — Ground colour rusty ochreous, becoming gradually darker towards end of abdomen; front of head, entire pro- and synthorax, the coxae outwardly, and apical abdominal segments, thinly overlaid with pale lilac pruinescence. No distinct dark markings on dorsum of thorax. Posterior lobe of prothorax raised and in the form of a thick low triangle, somewhat shiny and slightly hollowed out posteriorly, shaped as shown in P. AGUESSE's fig. 3A-B.

Legs pale ochreous, only outer faces of anterior femora with rusty brown streak; spines black. Wing venation pale yellow, the pterostigmata with their costal sides cream coloured and centred with grey.

Abdomen, segm. 1 unmarked; 2 only with diffuse middorsal band, strongly narrowing towards base of segment. Segm. 8 brownish olive, unmarked. Unlike most allied species, the posterior border of segm. 10 is only slightly pinched and not at all tuberculate medially. Vulvar spine strong, acuminate. (3)

Size small : ♂ abd. + app. 20.0 mm, hind wing 13.2 mm; ♀ 21.0, 14.4 mm, respectively.

As stated before, the male of *I. saharensis* is easily distinguished from *elegans* by the very different shape of its prothorax and also by the finely pointed inferior anal appendages of the abdomen. The inner branches of the superior pair in *saharensis* are finger-like and invariably crossed shortly after the bend (for figures, see P. AGUESSE, loc. cit.), resembling those of *I. genei* rather more closely. In typical *elegans*, on the other hand, these branches are much shorter, spike-like, directed straight down and running parallel in caudal view. As to the prothorax, our North African males agree with P. AGUESSE's sketches of the hind lobe, the entire (or slightly interrupted) pale-coloured basal rim preceding the median tubercle being especially noteworthy. In our Moroccan male this conspicuous yellow crest is slightly angular but uninterrupted medially.

The type of *Ischnura lamellata* KOLBE, a male with its terminal segments lost, is now before me. It is the same species as *I. elegans* (VANDER LIND.), as had been established already by E. SCHMIDT, who examined and re-identified the specimen in 1931. The locality label reads : « Algerien, zw. Blidah u. Medeah, 6-8.84, M. Quedenfeldt », « Type » (orange),

(3) The terminal abdominal segments of *I. saharensis* are of the ordinary elongate form, P. AGUESSE's sketch 3C being a poor representation.

« *Ischnura lamellata* n. sp. Kolbe » (Mus. Berlin). It is here selected as the lectotype of *I. lamellata* KOLBE (1885). P. AGUESSE's statement (1958b) that *saharensis* « ... ne se rencontre que là où manque *I. elegans* » is certainly incorrect as there is definite proof that the two species inhabit the same region.

From *I. genei* our species can be distinguished among other characters by the non-denticulate tips of the inferior appendages and the shape of the prothorax; *genei* is also a darker coloured and more hairy insect. Of the latter species I have for comparison good series of both sexes from Corsica (taken by myself in 1964 and 1965) and several hundred from Sicily. I think there can be no doubt that *saharensis* is more remotely allied to *elegans* than are either *genei* or *graellsii* and should therefore be given the rank of a full species, quite distinct from all other regional *Ischnura*.

The pair from the Oued Agoundis were the only zygopters noted at this locality. They were skimming the surface of the water in close company of each other.

The present locality record is the first one situated north of the Atlas mountains and hence falls within the range of *I. graellsii* and *pumilio* (cf. P. AGUESSE, 1958, map on p. 155).

Note. — There still remains a possibility that this species is the same as *Agrion algirum* SELYS (Rev. des Odon. 1850 : 186) from Algeria, the male of which is said to differ from *I. graellsii* by the absence of black lines at the lateral thoracic sutures and by its smaller size.

#### LIBELLULIDAE.

### *Orthetrum caerulescens* (FABRICIUS, 1798).

Hitherto only known from Esmir in N Morocco (R. MACLACHLAN, 1889).

### *Orthetrum chrysostigma* (BURMEISTER, 1839).

Material. — 3 ♂ (adult), Loc. 6; 2 ♂ (adult), Loc. 8; 1 ♂ (semi-adult), Loc. 12.

Earlier records are : Tanger (F. RIS, 1910), Rabat and Salé, and several localities in « Maroc saharien » and Algeria (P. AGUESSE & J.P. PRUJA, 1958a & 1958b).

*O. chrysostigma* has been discussed in some detail by E. SCHMIDT (1951) and K.F. BUCHHOLZ (1959), both authors supplying good figures of the male genitalia. In the venation our specimens show the same variation as reported by K. F. BUCHHOLZ for his series from the Ennedi mountains : there are more often two rows *Rs-Rspl* than only few duplicated cells and, what is more remarkable, in 5 males the vein *Cu*<sub>1</sub> in the

hind wing arises at the anal angle of the triangle whereas in only one it is placed fully 1 mm distal to that level. In all individuals the upper surface of the frons is conspicuously grey-blue in colour, the sides remaining yellow, and there is hardly any indication of a darker basal stripe at the frons. The very dark membranula is grey-white at extreme base only.

Measurements : abd. + app. 27.0-30.0 mm, hind wing 30.0-31.5 mm.

Apparently fairly common in Morocco, for it was also noticed (but not captured) at Loc. 13 and Loc. 10, all at rather high levels.

N. B. — I have not seen topotypical examples of *chrysostigma* from the Canary Islands, which are reportedly of large size. It is just possible that they can be distinguished from continental specimens, in which case the North African subspecies should bear the name *barbarum* (SELYS, 1849). However, there is a note in one of R. MACLACHLAN's papers (R. MACLACHLAN, 1882 : 179) in which he refers to H.A. HAGEN's opinion that *chrysostigma* (types ♂ ♀, taken in cop., in H.A. HAGEN's collection) and *barbara* are « certainly identical ». Material from the typical locality of *chrysostigma* (Teneriffe) is necessary to settle this point.

#### *Orthetrum nitidinerve* (SELYS, 1841).

Material. — 1 ♂ (semi-adult), Loc. 3; 2 ♀ (semi-adult), Loc. 8; 1 ♂ 1 ♀ (ad., in cop.), 1 ♀ (juvenile), Loc. 10, 7-VI-1966; 1 ♂ (adult), Loc. 15. Also observed at Loc. 13.

Previously known from Tanger (H.J. KOLBE, 1884) Morocco (F. RIS, 1910), the Moyen Atlas : Azrou, and the Haut Atlas : Reraia (K.J. VALLE, 1933).

#### *Orthetrum ramburi* (SELYS, 1848).

Material. — 1 ♂ (adult), Loc. 6. Also 1 ♂ (adult), labelled « N. Africa, Tanger » and identified with *O. ramburii* SELYS by ALBARDA and E. DE SELYS (ex coll. E. SELYS, in coll. H. ALBARDA (ML)).

Reported from Esmir by R. MACLACHLAN (1889).

This is presumably the species referred to by most authors as *O. anceps* (SCHNEIDER). E. SCHMIDT (1961 : 421-422) still considers *O. anceps* a subspecies of *caerulescens* (F.) on the assumption that intermediate forms (« Transiens-Formen ») between *caerulescens*, *ramburi* and *anceps* (sensu E. SCHMIDT) occur in the Mediterranean basin. As has been pointed out by ST. QUENTIN (1964 : 50), the only author who ever examined the type of *anceps* was H. A. HAGEN, who found it to be identical with *O. brunneum* (FONSC.). The species coming nearest to *anceps* auct. is *ramburi* SELYS (terr. typ. : Sardinia), which name should therefore be used as a substitute.

At the moment I am unable to distinguish between our Moroccan examples and a series of males from Asia Minor in the Leiden Museum, all of

the latter being assigned to *ramburi* by E. DE SELYS and H. A. ALBARDA. They agree in having only a single cell row *Rs-Rspl* and a white membranula; the dorsal surface of the frons is distinctly obscured, but the pale labium only darkened at extreme base of the midlobe. There are 11 *Ax* in the fore wings and the *Arc* is placed at *Ax*<sub>2</sub>. The genital organs agree tolerably well with MENER's picture (fig. 135) of « *anceps* » in F. RIS's monograph, drawn after an example from TANGER, but the resemblance is complete on comparing our specimens with K.F. BUCHHOLZ's (1954 : 65 fig. 8) more precise drawings of a male « *anceps* » from Paros-Marmara in Greece. His figures of the penis also correspond exactly with the (exposed) organ of the specimen recently taken in Morocco. This was captured almost simultaneously with 3 males of *O. chrysostigma*. I had no difficulty in keeping the two species apart as they settled on large boulders in the stream, the abdomen of *ramburi* being markedly wider and the thorax darker, more densely pruinescent, than in *chrysostigma*. I am deliberately of the opinion that *ramburi* is also specifically distinct from *caerulescens*, and that all « Transiens-Formen », if at all existing, require further careful study. *O. helena* BUCHHOLZ (1954 : 66-67, fig. 9), from Naxos, I consider only as a variety of *ramburi* (= *anceps* sensu K.F. BUCHHOLZ, loc. cit.).

### *Orthetrum trinacria* (SELYS, 1841).

Reported from Esmir by R. MACLACHLAN (1889) and from the coastal localities Salé (near Rabat) and Mehedia lagoon (Mehdiya near Kénitra ?) by P. AGUESSE & J.P. PRUJA (1958b).

### *Libellula q. quadrimaculata* LINNAEUS, 1758.

Material. — 1 ♂ (adult), Loc. 3, and one exuvia from the same locality.

A surprising discovery. As far as I am aware this is the first African record for a well-known and very common circumboreal species.

Several adults, most of them out of reach, were seen flying in the reed belt at the western shore of the lake. Only a single male was captured, the exuvia being picked up from a poplar sapling at the water's edge.

The specimen is quite normal, very mature, with rather tattered wings.

Measurements : abd. + app. 30.5 mm, hind wing 37.0 mm.

### *Diplacodes lefebvrei* (RAMBUR, 1842).

Recorded by R. MACLACHLAN (1889) and F. RIS (1911) from Esmir (sub *Diplacina flavistyla* RAMB.) and « Marokko », respectively. Also

known from the Rharb area (Merdja Bokka, not far from Kénitra), as reported by P. AGUESSE & J.P. PRUJA (1958a).

### *Crocothemis e. erythraea* (BRULLÉ, 1832).

**Material.** — 1 ♂ (adult), Loc. 13. Males were observed also at Loc. 6.

The few earlier known records are « Morocco » (F. RIS, 1911), Tanger (L. NAVÁS, 1913), and Merdja Bokka near Kénitra (P. AGUESSE & J.P. PRUJA, 1958a).

The present example is relatively of rather large size : abd. + app. 28.5 mm, hind wing 32.0 mm. Some recent writers are apparently inclined to consider *C. erythraea* a subspecies of *servilia* (DRURY) but I can see no reason to do so since nominotypical individuals of *erythraea* and *servilia*, from Greece and China, respectively, are very different insects structurally.

### *Brachythemis leucosticta* (BURMEISTER, 1839).

A single male, taken at light during the night, has been reported from the Forêt des Zaër, south of Rabat, by P. AGUESSE & J.P. PRUJA (1958a).

### *Sympetrum s. striolatum* (CHARPENTIER, 1840).

First recorded by K.J. VALLE (1933) from Reraia (Moyen Atlas) but later also from Ras-el-Ma (P. AGUESSE & J.P. PRUJA, 1958b).

### *Sympetrum fonscolombii* (SELYS, 1840).

**Material.** — 1 ♂, Loc. 3; 2 ♂ 1 ♀ (in cop.), Loc. 13. Also observed by me at Loc. 14 and in a garden at Marrakech. Lastly, 1 ♂ (adult), Moyen Atlas, 2000 m, 32 km S of Azrou, 25-VIII-1964, L. D. BRONGERSMA (ML).

Earlier records for this widely distributed species are Tanger (F. RIS, 1911), « Marokko » (O. LE ROI, 1915), and several coastal localities (P. AGUESSE & J.P. PRUJA 1958b).

Very common at Loc. 3 and extremely abundant above the dam at the barrage Cavignac (Loc. 13), males alighting on tall grass and dead branches. Several copulating pairs were noticed in the scrub far away from the lake.

*Sympetrum meridionale* (SELYS, 1841).

There are three known localities for this species in Morocco, all recorded by K. J. VALLE (1933) : Forêt de Mamora (westcoast, near Kénitra), Ras-el-Ma and Azrou (both Moyen Atlas).

*Sympetrum sanguineum* (MÜLLER, 1764).

I have seen no Moroccan records of this common species other than the one mentioned by F. CAPRA (1964), who says « ...in Marocco ed Algeria Settentrionale... ».

*Trithemis arteriosa* (BURMEISTER, 1839).

Reported from « Marokko » by F. RIS (1912).

P. AGUESSE & J. P. PRUJA (1958a & 1958b) give Agadir Tissint and Oued Seyad (both in the Moroccan Sahara) and Taskala, « dans le bas Draa », as localities.

*Trithemis annulata* (PALISOT DE BEAUVAIS, 1805).

**Material.** — 1 ♂ (adult), Loc. 8; 1 ♂ (adult), Marrakech, Aguedal Park, 9-VI-1966, author. Also observed by me at Loc. 10 and 13.

Previously recorded only from Agadir Tissint (Maroc saharien) and « Sahara occ. » (P. AGUESSE & J.P. PRUJA, 1958a & 1958b).

The present males are not entirely alike, the amber-coloured patch at the base of the hind wings in the example from Marrakech being much darker than in the other, with the basal cell of the cubital space centred with dark brown. In both specimens the dark red thorax and abdomen are thinly overled with pruinescence giving the body a light purplish tint.

In the Aguedal olive garden males were swarming during late afternoon over an irrigation ditch with a rich growth of *Myriophyllum*.

*Trithemis kirbyi ardens* GERSTÄCKER, 1891.

**Material.** — 1 ♂ (adult), Loc. 8; 1 ♂ (id.), 3 ♀ (all semiadult), Loc. 15. Besides these I can give the following visual records for the male of this very conspicuous dragonfly : Loc. 10, 12, 13 and 14.

Apparently not reported earlier from Morocco but evidently widely distributed. Thus far the northernmost records for the subspecies are the Hoggar mountains and Beni Abbès (NW. Sahara) in Algeria (D.E. KIMMINS, 1934, and C. NIELSEN, 1956).



*Male*. — The striking golden brown basal patches of the wings are relatively of small size. In the fore wings the colour does not extend beyond the distal side of *t* and in the hinder pair only two cells beyond the apex of the latter. The costal and median spaces are entirely hyaline, there are several uncoloured cells in the anal field, and the marginal cells of the hind wings where these attain their maximum width are likewise uncoloured.

Abdomen and appendages entirely scarlet, only the dorsum of segm. 1 and a tiny median triangle at the base of segm. 9 black.

*Female*. — The present females correspond tolerably well with F. RIs's description of his form *a* (1912, Lib. Mon. : 780). The golden basal spots of the hind wings are obliterated, forming diffuse basal patches filling up *sc* as far as  $Ax_2$  or  $Ax_3$ , *m* and (in one example) also *t*, which are separated from a characteristic light amber cloud, quite unconnected with the base and margin. Pterostigma longer than in the male.

Measurements : ♂ abd. + app. 20.7-22.2 mm, hind wing 26.5 mm, pterostigma hind wing 1.4-1.6 mm; ♀ 20.0-21.0 mm, 26.4-26.5 mm, 2.0 mm, respectively.

For comparison with the males I have good series of that sex from South Africa, Katanga and Tanganyika. The basal wing colour in all of these extends noticeably further distad but for the rest they exhibit much variation in colour : the dark spots on the terminal segments of abdomen and appendages may be present or absent even in individuals from the same habitat. Specimens from Madagascar, Eritrea and other regions in Africa are also available but too few in number to say much about their variation.

K.F. BUCHHOLZ (1959 : 95-97, fig. 24-25) has given good illustrations of the genital segment and penis of male *ardens*, taken from one of the original series in the Hamburg Museum, probably the only specimen of A. GERSTÄCKER's still in existence. K. F. BUCHHOLZ is of the opinion that more subspecies may prove distinguishable.

The fiery red males are very wary insects but quite conspicuous when darting about and settling on boulders and rocks in the stream. All females were taken at some distance from water in dry open country.

#### CORDULIIDAE.

### *Oxygastra curtisi* (DALE, 1834).

*Material*. — 1 ♀ (juvenile), W Morocco, Oued Cherrat, 30 km S of Rabat (Rabat-Casablanca road), 15-V-1961, J. DORGELO (MA).

New to the African continent and rather a surprising discovery.

As far as I can make out, the present female does not differ in any way from immature examples of that sex taken in western Europe. The

wings are stained with yellow all over the membrane, this colour deepening in tint towards the anterior border. Size rather small, hind wing measuring 31.0 mm in length.

A widely distributed species in southwestern Europe, locally common in the Iberian Peninsula and southern France but becoming scarcer towards the north and east. Few scattered localities only are known from southern England (terr. typ.), Holland, Belgium, the Rhine Province in western Germany, Switzerland (Genève and Ticino) and northwestern Italy. The species is near extinction in its northernmost settlements.

#### GOMPHIDAE.

### *Gomphus lucasi* SELYS, 1849 (fig. 6).

Extralimital material. — 1 ♂ (adult), labelled « Algier, zwischen Blidah u. Medeah, 6.4.84, M. Quedenfeldt » (one of H.J. KOLBE's specimens, ZMB). 1 ♀ (rather immature), with blue label « Orléansville » written in ink, and « *Gomphus Lucasii* S. ♀ » in E. SELYS' writing on white label (IRSN).

Not yet definitely known from Morocco.

A single immature female of the supposed *G. lucasi* has been reported from the Haut Atlas (Reraia) by K.J. VALLE (1933), but I suspect this to be a misidentified specimen of *G. simillimus maroccanus* m.

It does not appear that *G. lucasi* has been mentioned in the literature from outside Algeria whence it has repeatedly been recorded by several authors. It comes very near *simillimus* but its characters indicate, I believe, that it is best regarded as a distinct species.

Both sexes were first described and figured in 1849; the types from Algeria should be in the Paris Museum. In E. SELYS's collection at Brussels I have found only the juvenile female from Orléansville, mentioned by E. SELYS & H.A. HAGEN in the monograph. In addition to the excellent comparative descriptions found in the last-mentioned work, I here give a key that may serve to recognize it from its nearest relative, *G. simillimus* SELYS. The penis of the latter has been figured by E. SCHMIDT (1961). E. SELYS & H.A. HAGEN (loc. cit.) observed that in *lucasi* « les organes génitaux du 2<sup>e</sup> segment sont moins proéminents », a statement which I am now able to confirm; I have failed, however, to find differences in the penile structure between the two species.

### *Gomphus simillimus maroccanus* subspec. n. (fig. 8-9).

Material. — 2 ♂ (adult), Loc. 1; 1 ♂ (adult), Moyen-Atlas, El Hajeb (between Meknès and Azrou) ca 1050 m, 25-V-1966, author; 1 ♂ (adult), Loc. 6. Also 10 exuviae (7 ♂ 3 ♀) of slightly doubtful identity, Loc. 3 (all ML). 2 ♀ (adult), Moyen Atlas, Ifrane, 1600 m, 15/16-VII-

1935, A. BALL (IRSN). 5 ♂ 2 ♀, labelled « Maroc », all except 1 ♀ identified by R. MARTIN as *G. simillimus*, the second ♀ with « simill. (Lucasi ?) », in coll. R. MARTIN (MP). Holotype ♂, Morocco, El Hajeb (ML); allotype ♀ Morocco, Ifrane (IRSN).

Previous records of regional *G. simillimus* — most likely applying to the present subspecies — are « Maroc » (R. MARTIN, 1910) and the three localities Ifrane, Sidi Ouaddar and Ait Melloul, mentioned by P. AGUESSE & J. P. PRUJA (1958b). See also under *G. lucasi* SELYS. It would be interesting to examine Algerian *simillimus*, of which MARTIN (1910 : 100) says : « Bords du ruisseau d'El-Guerra et de la Seybouse, en juin. Il paraît être plus commun au Maroc. » O. LE ROI (1915) records it from Tunisia without comment and E. SCHMIDT (1961) writes that in Algeria *lucasi* and *simillimus* may occur together.

The present males from Morocco are practically alike except for slight differences in body size. When I examined my first specimen I at once noticed the somewhat reduced black markings of the thorax, an unusual feature for this species. Further investigation proved this character to be one of the most striking by which it can, in fact, be distinguished from typical *simillimus* of southwestern Europe. Apart from the colour differences enumerated in the key, the males can be held apart by features of the anal appendages, which are here figured for *s. maroccanus* (fig. 9).

The measurements of the subspecies are : ♂ abd. + app. 30.5-33.5 mm, hind wing 27.0-29.4 mm, pterostigma fore wing 2.0 mm; ♀ 37.0-38.0, 33.3-34.0, 3.0 mm, respectively. It will be noted that the females from Ifrane, like specimens of *Onychogomphus uncatatus* (Charp.) taken in the same locality, are of exceptional large size.

The exuviae of the Aaoua lake (Loc. 3) are rather puzzling. All belong to a single species. Unfortunately the only adult *Gomphus* noticed was a male observed just upon arrival at the lake, and this I failed to capture. In the key published by E. SCHMIDT (1936) the exuviae run out to either *simillimus* or *lucasi*, measuring 28.5-30.0 mm for the male, 29.5-30.4 mm for the female. There is, however, a peculiar discrepancy with regard to the form of the initial valvula vulvae of the female, the tubercles (fig. 10) being comparatively of large size, agreeing much more closely with those of the allied species *G. graslini* SELYS, of which I possess specimens of southern France reared from larvae. For comparison I have a single exuvia of female *simillimus*, from Indre in France (ex coll. R. MARTIN), which differs from the present specimens by having the vulvar tubercles more closely approximated, blunter and only about half as long. I have failed to see much difference in the structure of the labium but the lateral spines at the abdominal segments 7-9 appear longer in our material than they are in *simillimus*, in two females even the 6th segment bearing a minute spine. Would these exuviae perhaps belong to *G. graslini*, a species not yet known from Africa ?

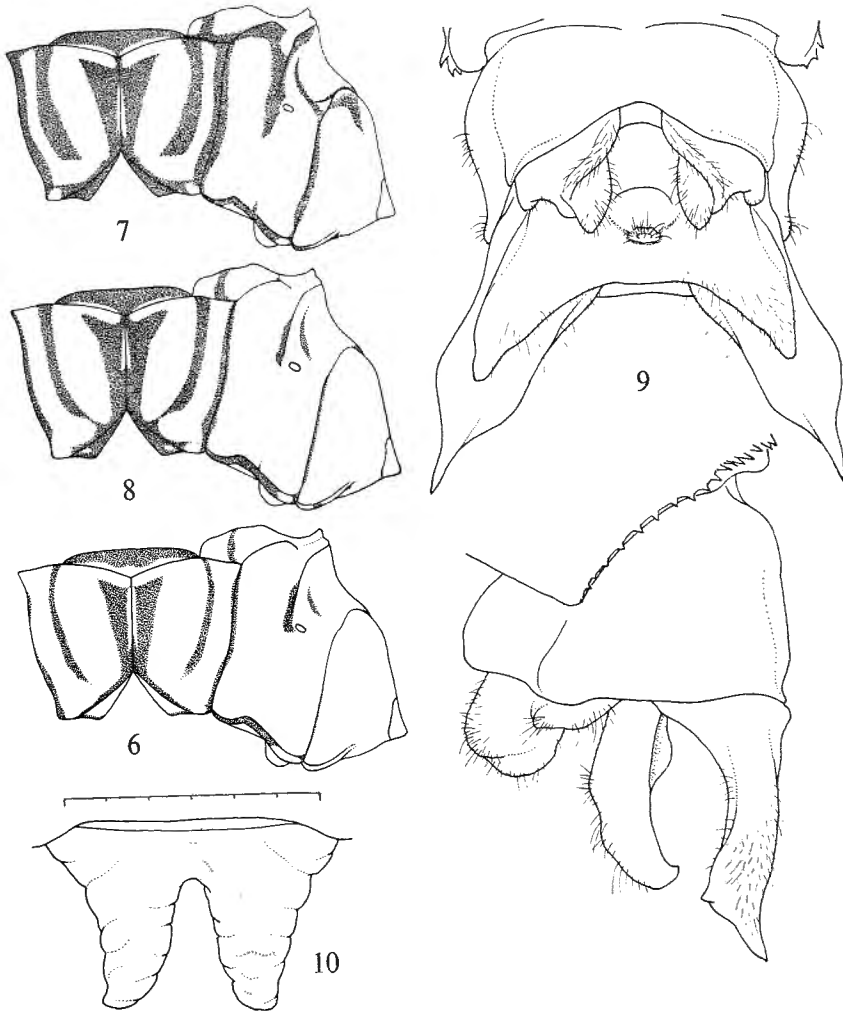


Fig. 6 : *Gomphus lucasi* SELYS, colour design of synthorax of ♂ from Algeria (Medeah). — Fig. 7 : *G. s. simillimus* SELYS, the same of ♂ from S. France (Montpellier). — Fig. 8 : *G. s. maroccanus* subsp. nov., the same of ♂ from Morocco (El Hajeb). — Fig. 9 : *G. s. maroccanus* subsp. nov., from Morocco (El Hajeb), apex of ♂ abdomen, ventral and right lateral view. — Fig. 10 : *Gomphus* spec. indet., from Morocco (Loc. 3), valvula vulvae of ♀ exuvia, ventral view; scale-line = 0.6 mm.

The following key is based on about sixty individuals (both sexes) of *G. s. simillimus* from various localities in Belgium, France and Spain (ML and IRSN); on 4 males and 2 females of *G. s. maroccanus* subsp. nov. from Morocco; and on 1 male and 1 female (the latter incomplete) of *G. lucasi* SELYS from Algeria.

## MALES.

1. Postocellar crest of vertex of equal width throughout, in the form of a rather narrow, undulated ridge; its lateral angles evenly rounded and only little more elevated than the part between; crest entirely green but vertex otherwise black. At least the outer faces of second segment of all tarsi green. Black design at labroclypeal and frontoclypeal sutures reduced to mere hair-lines, usually wanting or barely indicated at the sides. Black thoracic markings greatly reduced, mesothoracic collar not interrupted by black and antehumeral stripe narrower than the space separating it from the humeral line (fig. 6). Sup. anal app. slender, apices acuminate, insensibly pointed; branches of inf. app. widely divaricate, their outer border well visible on either side of sup. app., if viewed from above. Dorsal longitudinal yellow spots on abd.-segm. 5-9 subparallel-sided; spot on 9 widest and that on 10 complete, broadly oval. Size smaller and stature slightly more slender. Hab. : Algeria . . . . . *lucasi*
- Postocellar crest of vertex not undulated but arched in front, its side portions more oblique and wider, distinctly swollen and more elevated than at middle; crest for the greater part black. Tarsal segments invariably black. Black design in front of head and thoracic markings more pronounced. Sup. anal app. more swollen and downcurved, apices more abruptly pointed and upturned. Body more compactly built . 2
2. Vertex wholly black. Black stripe at base of frons straight, its depth about one-third or less of whole length of frons. Black design of thorax occupying more of the surface, the antehumeral and humeral bands at least equal in width to the green interspace; lateral lines heavier (fig. 7). Dorsal longitudinal yellow spots on abd.-segm. 5-8 broader anteriorly than behind, usually tapered and pointed apically; spot on 9 oval, widest at middle, the one on 10 usually small, triangular, occupying only distal half of segment. Sup. anal app. thick, strongly downcurved, terminating suddenly in a little, very acute, slightly upturned point; outer border of branches of inf. app. just visible on each side of sup. app. if viewed from above. Hab. : SW Europe . . . . . *s. simillimus*
- Vertex black, the lateral tubercles of the postocellar ridge green. Black stripe at base of frons thick, its depth at middle about two-fifths whole length of frons. Black design of thorax occupying less of the surface, antehumeral stripe wider than the humeral but narrower than the green interspace; humeral stripe linear and lateral lines of thorax very fine (fig. 8). Dorsal longitudinal spots on abd.-segm. 5-8 widest at extreme base, then subparallel-sided almost to apex of segments, each terminating in a short blunt point, the spot on 9 parallel-sided, abruptly pointed apically, the one on 10 narrowly oval but occasionally reduced to mere spots. Sup. anal app. more slender, definitely less downbent, terminating more gradually in a long, very acute,

slightly upturned point; branches of inf. app. not visible if viewed from above (fig. 9). Hab. : Morocco . . . . . *s. maroccanus*

#### FEMALES.

1. Postocellar crest of vertex entirely green, shaped as in male but lateral extremities abruptly raised to form a pair of tiny cone-shaped processes near margin of compound eye. Tarsi as in male. Black lines at anterior sutures of head as in male, the stripe at base of frons narrow, less definitely bilobed at middle but indented by yellow in front of median ocellus. Black thoracic markings as in male but antehumeral stripes a little wider. Abdominal markings and genital organs uncertain. *lucasi*
- Postocellar crest black, made up of three separate portions : a blunt slightly arched ridge, concave anteriorly, extending between the lateral ocelli, and a pair of low tubercles, one on each side behind lateral ocellus but placed a little more posteriorly . . . . . 2
2. Area behind postocellar crest black, occasionally with tiny median spot of green, hence vertex almost or wholly black; blunt lateral tubercles comparatively small though distinctly raised. Frontoclypeal suture with black hair-line incomplete laterally. Green area enclosed by antehumeral and humeral stripes at most equal in width to the black stripes, usually distinctly narrower and antehumeral stripe wider than humeral; black line at second suture distinct. Tarsi black. Abdominal markings much as described for the male . . . . . *s. simillimus*
- Area behind postocellar crest (including the tubercles) green but sometimes black at middle only; blunt lateral tubercles of larger size, flatter, and placed more transversely. Frontoclypeal suture more distinctly black but incomplete laterally. Green area enclosed by antehumeral and humeral stripes distinctly wider than the black stripes themselves; black line at second lateral suture obsolete. Second tarsal segment of all legs green exteriorly. Abdominal markings much as described for the male . . . . . *s. maroccanus*

There is no need to add to the above as far as the colour design of the two sexes is concerned. Our material of *lucasi* is very limited, and I have not seen a perfect female of the latter : most of its abdomen, if at all belonging to this example, having been found loose in the box.

N. B. — Since the above was written I have seen several Algerian examples of *G. lucasi*, adults and larvae, in the Paris Museum. These were discussed by R. MARTIN in his special paper (1910). I have not studied these specimens any further and the type of *G. graslini* appears to be lost.

### *Paragomphus genei* (SELYS, 1841) (fig. 11-12).

**Material.** — 1 ♂ (adult), labelled « Maroc », unidentified in R. MARTIN's collection (MP). 3 ♂ exuviae, Loc. 15.

I have found no earlier records for this species in the literature on Moroccan dragonflies.

**Extralimital material.** — 1 ♂ (adult), labelled on light green « Onychog. Genei S. Sardaigne (Costa) » in E. SELYS' writing (IRSN); 1 ♀ (adult), labelled in print « Oristano » [W Sardinia] and inscribed on white « Onychogomphus Genei S. ♀ Oristano Costa » in E. SELYS's writing (IRSN); 1 ♂ (adult), « Bayrut » yellow label, E. SELYS's writing), « Onychog. Hageni ♂ S. ♂ » (white label, ditto), « Faux Hageni de Syria (légère var. de pumilio à feuilles sm. 8-9 limbées de noir » (yellow label, ditto) (IRSN). 1 ♂ 1 ♀ (adult), « Sardinia » (written blue labels) and « Onych. Genei, Rb. » (pale blue labels written by R. MACLACHLAN), holotype and allotype *Gomphus excelsus* COSTA, 1884 (ex coll. R. MACLACHLAN, BM). 1 ♂ (adult), Algeria, labelled « Biskra, fontaine chaude » in R. MARTIN's writing (MP). 1 ♂ 1 ♀ (adult), labelled « Tozeur (Tunisie), Octobre 1923, ded. H. Gauthier », ♀ with identification label in J. L. LACROIX's hand « Onychogomphus, peut-être nouv. à étudier », in coll. J. L. LACROIX (MP).

In addition to the old specimens enumerated above, I have before me 2 ♂ and 1 ♀ of « *P. hageni* (SELYS) » from Rusinga I., Lake Victoria (ex coll. E. PINHEY) and a long series of both sexes, also from Central Africa, collected by Mr. G. M. L. BERGERS near Korogwe in Tanganyika (all ML). The latter include all sizes and colour variations already known to occur throughout the whole of continental Africa of the species universally known as *P. hageni* (SELYS).

The type of *Gomphus Genei* SELYS, a female from Sicily in the « Musée de Turin », is probably no more in existence. I have failed to recover it while visiting the University Museum at Torino in 1959. The types of *Onychogomphus Hagenii* SELYS, 1871, first described in 1854 as *O. Genei* by E. DE SELYS, are a male and female from « Egypte », leg. EHRENBERG, Mus. Berol., now still in the Berlin Museum.

An excellent account of the history of these two much discussed insects, with annotations by F. RIS, is to be found in a paper by K.J. MORTON (1924).

After exhaustive structural comparisons of both sexes and the consultation of the illustrations given by H.A. HAGEN (E. SELYS & H.A. HAGEN, 1850), F. RIS (1921), K.H. BARNARD (1937), E.C.G. PINHEY (1951, 1961 and 1962), and C. CONCI & C. NIELSEN (1956), I conclude that *hageni* is untenable and must fall as a synonym of *genei*. R. MACLACHLAN (1897) had already found that Algerian individuals of the supposed *hageni* from Biskra differed somewhat from others collected at Lac Hou-

beira, the latter agreeing more closely with the description of *genei*. He then remarked on the difficulty of separating these two forms if certain colour features are excluded from consideration. O. LE ROI (1915), quoting R. MACLACHLAN and R. MARTIN's records of Algerian *genei* and *hageni*, rightly wonders : « Es ist immerhin auffallend, dass diese Art und die vorige an denselben Örtlichkeiten vorkommen sollen. » I wish to call attention also to E.C.G. PINHEY (1961), who described the great variation occurring within populations of « *hageni* » from various localities in South and Central Africa. The same author in 1962 gave full references of *P. genei* and *hageni*, as well as of some other species probably involved in synonymy.

On comparing our example of *genei* from Sardinia with that of *hageni* from Beirut, it is clear that these two represent two extremes of variation very nearly equal to those found in our large series taken in Tanganyika, the corresponding extremes among the latter being even more pronounced; at the same time, however, all intergradations exist and a continuous range of intensity of marking and body size is to be found. I therefore suspect that if a large series were collected from each of the Mediterranean settlements of *genei* a similar range of variation will be found, analogous to certain other gomphids, for example *Onychogomphus forcipatus*.

The male of *P. genei* is easily distinguished from allied species, including *cognatus* RAMB. and *pumilio* RAMB., by the form of its anal appendages and accessory genitalia. Some slight variation exists in the configuration of the appendix inferior, which in no two males seems to be exactly similar (fig. 11-12); but in all males examined by me the apex of the superior appendage is a little excised or bidentate, a feature not correctly shown in C. CONCI & C. NIELSEN's drawing (loc. cit., fig. 66-67).

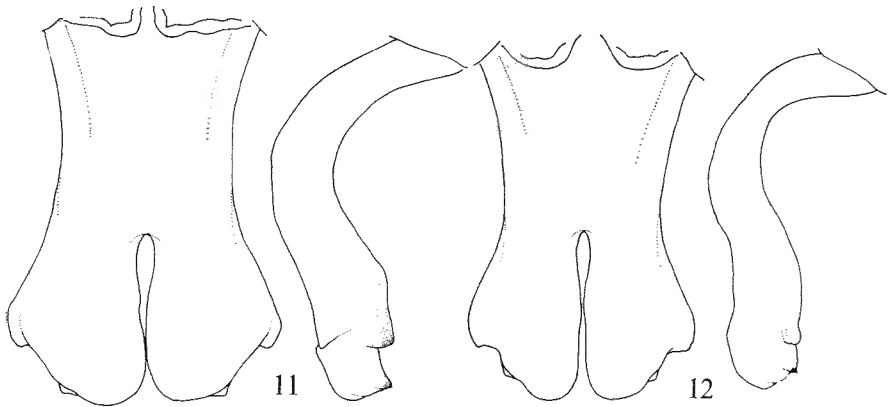


Fig. 11-12 : *Paragomphus genei* (SELYS), ♂ appendix inferior, ventral and left lateral view; fig. 11, from Sardinia; fig. 12, from Syria (Beirut). Same magnification.



The irregularly rectangular shape of the posterior hamule is highly characteristic, as is also the penis, whose apical segment is broad with two short widely separated prongs (no filaments), which lie within the cowl-like projection on the basal segment. The penis is also figured by E. SCHMIDT (1961 : 414 fig. 5e).

A detailed and well illustrated description of the larval exuvia of *P. genei* was given by K. ANDER (1929, sub *Mesogomphus Hageni*) after a specimen from Algeria. Other descriptions were subsequently published by K.H. BARNARD (1937), who had material from South Africa, and P.S. CORBET (1957), who described and figured examples obtained from the Lakes Albert and Victoria. Both authors drew attention to the difference in relative length of the paraprocts and its use as a specific character. With these descriptions and drawings our Moroccan exuviae fully agree; the dark markings on the dorsum of the sixth abdominal segment are decidedly striking, precisely similar in form to those figured by P.S. CORBET, and their presence may be of equal use as a character for recognition.

Of the five exuviae picked up from the silt bar along the Oued Tensift, three were of *P. genei* and two of *O. costae* (see under that species).

### *Onychogomphus costae* SELYS, 1885 (fig. 13-17).

**Material.** — 9 ♂ (1 juvenile) 2 ♀ (both in cop.) and 2 exuviae, Loc. 15 (ML). Also : 1 ♂ (adult), Maroc, Kasba Goundala, 1300 m, 26-VI-1934, A. BALL; 1 ♂ 1 ♀ (♂ app. missing), Maroc, Marrakech, Oued Tensift, 450 m, 15-VI-1934, A. BALL (all IRSN). 1 ♂, Maroc, 25-V-1923, identified with *O. genei* SELYS, in coll. J. L. LACROIX (MP).

**Extralimital material.** — 1 ♂ (juv.), « Oran » (written on white label), « *Onychog. costae* S. ♂ » (pale green label, E. SELYS's writing), possibly holotype? (IRSN). 1 ♀ (adult), Zaragoza [Spain] 23 Jul. 98, identified by E. SCHMIDT, X.1957 (IRSN). 1 ♂ (adult), Algeria, Biskra, 26-V-1897, A. E. EATON, identified by R. MACLACHLAN (MP); 1 ♂ (much damaged), Biskra (MP); 1 ♀, Constantine 339 (Algeria), all identified with *O. genei* SEL. by R. MARTIN (MP). Besides these, I have examined several specimens from Spain (Sobradiel and Zaragoza) as well as others labelled « Orihuela Andréu » and « Flix », also in Spain, most of these ex coll. L. NAVÁS and labelled *O. genei* by R. MARTIN and L. NAVÁS (MP).

Not previously known from Morocco but occurs in Algeria and Tunisia, being found also in Spain (e.g. A. BENITEZ, 1950, sub *Mesogomphus genei*) and Portugal (sec. E. SELYS).

For a historical review of this remarkable species see K.J. MORTON (1924). First described and figured in 1871 sub *Onychogomphus Genei* by E. DE SELYS, who thought the specimen in his possession from Oran to

represent the then unknown male of his *O. genei*, the same example being later renamed *O. costae* SELYS, 1885 (C. R. Soc. ent. Belg. (3) 66 : CXLVI).

A slender pale-coloured insect recalling other deserticolous gomphids like *Paragomphus pumilio* (RAMB.) and *Anormogomphus*; it is, however, a true *Onychogomphus* with somewhat reduced venation and rather unusually shaped genitalia and anal appendages.

The original description of the male (sub *O. genei* SELYS) is very full but is perhaps based on an adult specimen, the topotypical male referred to above being slightly immature. R. MACLACHLAN (1897) was the first to describe the female of *O. costae*, after two specimens from Biskra in Algeria. It resembles the male in most respects and the sexual differences in the structure of the occipital plate are almost negligible. The following notes on the colour scheme and structural characters can now be supplied in addition to those already known.

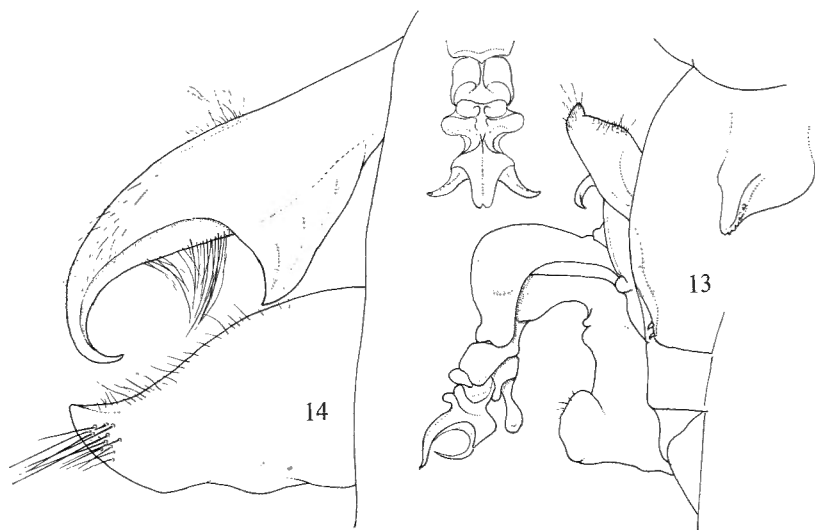


Fig. 13-14 : *Onychogomphus costae* SELYS, ♂ from Morocco (Loc. 15); fig. 13, genitalia, left lateral view, with apex of penis, ventral view; fig. 14, hamuli of second specimen, slightly oblique left lateral view, more highly magnified.

**Male.** — General ground colour light ochraceous buff with slightest intermingling of opaline green on the antehumeral bands and meso-meta-epimeral parts of thorax, the frontal tubercles being of a bluish milky-white tint. All brown markings of head and thorax ill-defined, usually distinctly cinnamon-buff but often paler, dark ochraceous buff, occasionally scarcely outlined and of a still lighter colour. Thoracic sides growing paler and acquiring a delicate lemon yellow tint across the lower parts. Neuration brown, costa and antenodal cross-veins in costal space bright

yellow; pterostigma bright yellow heavily framed in black, the costal side thickest. Membranula white. Neuration as in typical *Onychogomphus* but more open; arculus sectors widely separated at origin; two antefurcal cross-veins in fore wing, one in hind wing. Anal loop two-celled. Anal triangle usually four-celled, more rarely made up of only three cells.

Ground colour of abdominal segments 1-6 pale ochreous (ochraceous buff), with admixture of palest turtle green in old males; succeeding segments including anal appendages more vividly coloured, ochraceous buff, definitely ochraceous orange in live specimens. Thorax and abdomen sparsely marked with dark brown, as follows : impressed anterior area in front of mesothoracic collar; a pair of transverse streaks at the supplementary carinae, followed by a pair of approximated subapical points on mid-dorsum of segm. 2-6 of abdomen; the intersegmental rings of the same segments; and traces of impressed points near the base of segm. 10. Beyond the black denticulate margin of segm. 10 the posterior border is somewhat swollen, forming a low, glossy jet-black triangle. Minute rasp-like black denticles are found on the following parts of the body : frontal tubercles, dorsal ridges of ante-alar triangles, at all transverse subapical

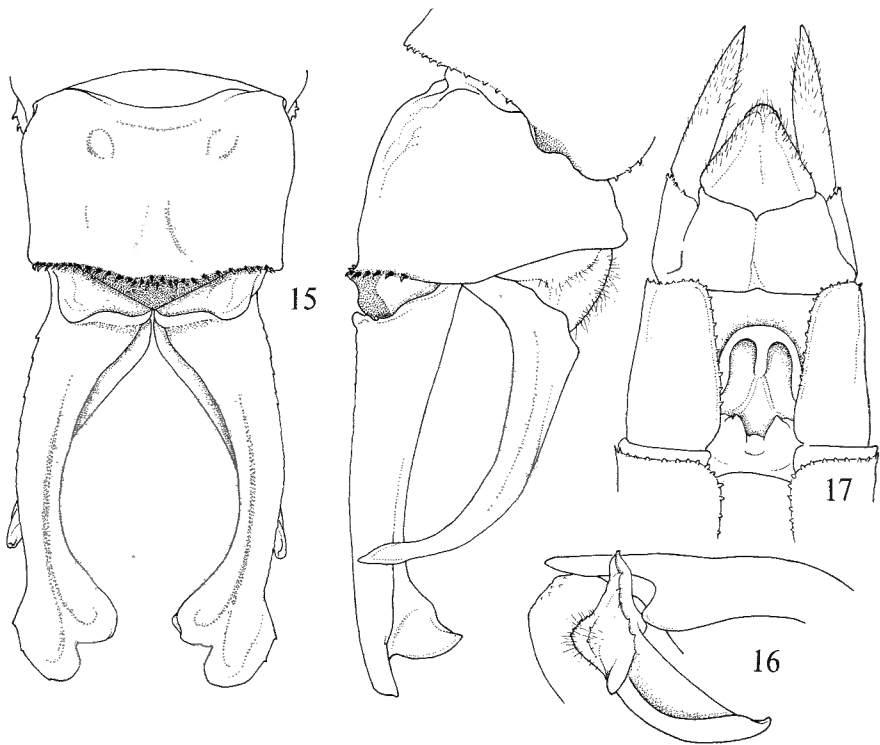


Fig. 15-17 : *Onychogomphus costae* SELYS, from Morocco (Loc. 15); fig. 15, apex of ♂ abdomen, dorsal and right lateral view; fig. 16, apical portion of right pair of ♂ appendages, caudal view more highly magnified; fig. 17, apex of ♀ abdomen, showing genital structures, ventral view.

carinae of abdominal segments 2-9, and on middorsum of segm. 3-6. Deep black tubercular points are situated laterally at the intersegmental rings of segm. 1 and 3-7, and at the carinae of 8-9.

Genitalia as in fig. 13-14. Colour yellow, the outcurved tips of anterior hamuli and the tooth at apex of posterior hamuli, black. Penis-guard of enormous size, strongly hollowed out within and embracing most of the penis stem in repose. Vesicle of penis subtriangular, of the cleft-pyramidal type, the leaf-like blades widely divaricate; stem normal, with minute exterior tooth; median segment with a slender club-shaped interior process (prepuce); basal portion (collar) of last segment opaque black, the rest transparent, glans truncated apically, flagellum divided into two short, widely distant filaments.

Anal appendages as in fig. 15-16, unicoloured.

*Female.* — Occipital plate of simple structure, unarmed, dorsal surface slightly concave on each side of the middle, posterior one-third with a tiny low median tubercle (smaller than in the male). Genital structures and appendages as in fig. 17.

Measurements : ♂ abd. + app. 30.8-34.0 mm, hind wing 23.5-26.2 mm, pterostigma fore wing 2.0-2.3 mm; ♀ 32.0-33.0, 26.3-26.8 and 2.5 mm, respectively.

The larva of *O. costae* has been characterized and well figured by E. SCHMIDT (1936) after exuviae collected by himself in NW Algeria. Our specimens agree with the key characters given by E. SCHMIDT, except that the pattern here is well shown. The abdominal segments 3-9 bear a pair of closely approximated dark middorsal points, one on either side in front of the median tubercles, the same segments carrying moreover a more transversely placed spot on each side about midway between the dorsal tubercles and lateral margins.

It was only the finding of these empty skins that directed my attention to the presence of this handsome little gomphid. By a remarkable stroke of luck I found the exuviae of both this species and *Paragomphus genei*, on small stones below the right bank of the Tensift. They were close to the water's edge in a spot where the current was somewhat faster, flowing ripply over a gravel bar. No adults of either species were to be found here or over the water, but an inspection of the adjoining fields proved more successful, *O. costae* being soon noticed on the plateau some ten feet above the river bed. They were flushed from bare patches of sand on which the males settled after short flights, evidently in search of females. A few juveniles were also seen but most specimens were fully mature, two pairs being taken in copulation. Like the solitary males, the couples rested on the bare ground. Unfortunately no single *Paragomphus genei* was to be seen and it was too late to look for them at the gravel bars in the stream bed.

*Onychogomphus forcipatus unguiculatus* (VANDER LINDEN, 1820).

**Material.** — 6 ♂ 1 ♀ (all adult), Loc. 6 (ML, IRSN).

Apparently not previously reported from Morocco, though well known from Algeria.

Though showing the usual colour variation of the terminal segments of abdomen and appendages, the present specimens are profusely marked with yellow and agree closely with examples of *unguiculatus* in our collection from southern France, central Spain, and with a near topotypical male from the Italian Apennines (Ronta near Mugello, 400 m, ex coll. K.J. MORTON). In all of these the branches of the appendix inferior possess the strongly recurved apices, so well shown in H.A. HAGEN's figure in the *Monographie des Gomphines* (1858) for a male from Algeria. For further particulars, see below.

The anal appendages are orange but in one example the inferior one is almost black.

Measurements: ♂ abd. + app. 34.5-36.8 mm, hind wing 29.0-30.7 mm; ♀ 35.3 and 32.0 mm, respectively.

GENERAL REMARKS ON THE MORPHOLOGY AND DISTRIBUTION OF *O. forcipatus* (L.)

It is generally understood that colour variation is very marked throughout the extensive range of this polytypic species. Broadly speaking, populations inhabiting northwestern Europe are darker than those found in southern countries but all degrees of intergradation occur between the more typical strains of *forcipatus* and those which are thought to represent the southern subspecies *unguiculatus*. Individuals obtained in Macedonia and Greece, for example, show an excess of yellow colouring as compared with the average amount observed in typical *forcipatus*. On the other hand, specimens exhibiting extreme melanism can be found in places where one would expect lighter insects to occur. (4) Considering the extent of light body markings alone, these southern populations are practically indistinguishable from the profusely marked *unguiculatus* occurring elsewhere in the Mediterranean so as to make recognition of subspecies well-nigh impossible.

(4) Special mention should here be made of an altogether extreme case of melanism exemplified by an adult male of *O. forcipatus* from Austria. In this specimen the thorax and abdomen are predominantly black instead of yellow. There are traces only of a humeral line, all remaining light spots on the thorax being completely isolated; the meso- and metepimeral light bands are much narrower than usual, the interspace being black save for three isolated light spots. The green marks on the abdominal segments 5-6 are devoid of the posterior prolongations, which on 2-4 and 7 are much reduced in size; segm. 8-9 only bear small lateral spots, while 10 is marked with yellow only along posterior border; the anal appendages are black. This very aberrant male (one of several noticed) was taken by me alongside a brook at Schwarzensee (near St. Wolfgang, 750 m, 28-VI-1963, in Ober-Österreich).

In spite of the above and ignoring all colour features, there still remains the character of the sexual organs to prove that in all probability two or even more recognizable subspecies are involved. A study of the male anal appendages and female occipital region was initiated already more than a century ago by E. DE SELYS & H.A. HAGEN (1858). This investigation can only be looked upon as tentative, mainly because in those days only solitary specimens from any one locality were known. By this time, however, with good series from many localities becoming available, further research on similar lines will no doubt result in a better understanding of the racial problems involved. The following preliminary notes based on material in the Leiden Museum, apply exclusively to the configuration of the appendix inferior of the male. They will, I hope, stimulate students who might undertake a revision of the *O. forcipatus* group to pay special attention to the sexual organs generally.

*O. forcipatus forcipatus* (LINNAEUS, 1758). — Making allowance for slight inter-population variation to exist in the length and direction of the apical portion of the appendix inferior, its general shape can be described as follows. The subterminal projection arising from the upper surface of each branch follows its main curvature just beyond a low ventral convexity, representing the true apex of the branch and terminating in a slightly upturned finger-like or bluntly pointed cone, which is directed caudad (see, for instance, D. ST. QUENTIN, 1965b, fig. 3f).

Males corresponding with this type have been examined by me from the following localities in West and Central Europe : Benelux countries, France (dép. Indre, Yonne, Charente, Dordogne and Lot), Western Germany, Switzerland, Austria, northern Italy (Levico in Trentino), Jugoslavia (Dalmatia, Skopje, Treska river and Ochrida lake), Macedonia, Greece (including Poros), and Bulgaria (Roman, between Lovca and Vratca). With regard to the extent of yellow body markings the specimens from Greece are among the lightest in our collection.

*O. forcipatus unguiculatus* (VANDER LINDEN, 1820). — The branches of the appendix inferior are provided dorsally with a well defined subterminal protuberance, which is usually distinctly raised and often abruptly hooked and recurved, the true apex of the branch itself being much swollen and bluntly rounded, as shown in H.A. HAGEN's sketch (loc. cit.) for specimens from Nice and Algeria. All insects having this form of appendix are approximately alike and have been found in southern France (dép. Gard and Pyrénées Orient.), Central Spain (prov. of Jaén) and Morocco. The solitary male from the Etruscan Apennines, mentioned earlier, also conforms closely to this type, being altogether different structurally from the Trentino males referred to above under typical *forcipatus*. This is rather surprising, especially because a male *unguiculatus* reported from Livorno and figured recently by D. ST. QUENTIN (1965b) possesses a differently shaped appendix clearly suggesting nominotypical *forcipatus*. On the basis of this character it would mean that the latter not only

replaces *unquiculatus* north of the Po valley but also that it ranges much farther south, extending along the westcoast of the Peninsula. It seems obvious, therefore, that C. CONCI was wrong in assigning all Italian *forcipatus* to the southern subspecies (see C. CONCI & C. NIELSEN, 1956). A definite solution as to the proper status of *unquiculatus* can only be arrived at by a re-examination of the terminalia of a topotypical male from Bologna. At all events the occurrence of two different forms of *forcipatus* on the mainland of Italy seems to be well established.

As to the distribution of *O. forcipatus* in France, it would seem that intermediate forms between the two subspecies — if existing at all — are to be looked for in that part of the country which is situated between the valleys of the Lot and Aveyron in the north and the Mediterranean provinces occupied by *unquiculatus* in the south. Specimens which I have seen from east of the Rhône valley (Basses Alpes and Drôme) appear to come nearer *forcipatus* than *unquiculatus*.

I agree with D. ST. QUENTIN (1965b) that populations inhabiting some of the Mediterranean islands (i.e. *siculus* SELYS, 1858, from Sicily and *cyprinus* SCHMIDT, 1954, from Cyprus), are sufficiently recognizable to merit racial distinction. On the other hand, the inclusion of *O. lefebvrei* (RAMB.) from Egypt (and Syria?) in the Rassenkreis of *forcipatus* would seem to me going too far, Syrian individuals from Beyrut in the Leiden Museum being very different structurally. In this connection it may be remembered that another subspecies of *forcipatus*, approaching *unquiculatus* and figured also by H.A. HAGEN (loc. cit.), was reported from Trebizond (NE. Turkey).

### *Onychogomphus uncatus* (CHARPENTIER, 1840).

**Material.** — 2 ♂ (juv., with exuviae), Loc. 4; 1 ♂ (adult), Loc. 8; also 1 ♂ (adult), Haut Atlas, Oued N'fiss near Ouirgane, 1000 m, 2-VI-1966, author. In addition to these, several exuviae without imagines, Loc. 4 (all ML). Also 1 ♂ (ad.), Kasba Goundala (Moyen Atlas), 26-VI-1934, 1300 m, A. BALL, and 3 ♂ 2 ♀ (all adult) from Ifrane (Moyen Atlas), 15-16-VII-1934, 1600 m, A. BALL (IRSN); and 1 ♂ 1 ♀ (both freshly emerged), Ifrane (id.), 22 and 26-V-1961, J. DORGELO (MA).

Earlier records of this species are Benzus Bay (R. MACLACHLAN, 1889), Ain Chkeff near Fès (P. AGUESSE & J.P. PRUJA, 1958a), and Ifrane (P. AGUESSE & J.P. PRUJA, 1958b).

A fine series containing some very large specimens, especially the females taken at Ifrane being superior in size to individuals in our collection that were obtained at lower altitudes in southern Europe.

Measurements are : ♂ (Goundala) abd. + app. 37.4, hind wing 30.0 mm; ♂ (Oued N'Fiss) 38.0 and 31.0 mm; ♂ (Ifrane) 40.0-43.0 and

31.5-32.5 mm; ♂ (Loc. 8) 39.5 and 31.0 mm, respectively; ♀ (Ifrane) 39.0 and 33.9-35.0 mm, respectively.

On may 26, 1966, while spending a few hours' collecting at the stream near Ifrane, a mass emergence of this gomphid was witnessed soon after our arrival, at about 9.00 a.m. Many freshly emerged adults, beaten up on approaching the bank, made their way straight to the trees, while others were still drying their wings on the empty skins or clung to the vegetation. A search was then made for exuviae and a far greater number of these were noticed along the short stretch of the stream visited. One hour later no more specimens emerged and only very few males, not fully mature, were seen or captured farther away from the water.

#### CORDULEGASTERIDAE.

#### THE *Cordulegaster boltoni* (DONOVAN) COMPLEX.

It is only too well known that this polytypic species, or « Rassenkreis », still needs a careful analysis on a broad scale. In recent years some authors, i.e. D. ST. QUENTIN (1952 and 1957) and G. JURZITZA (1965), have attempted to arrive at a better understanding regarding the inter-relationship of the components of this group and their limits of distribution. The results were admitted to be far from satisfactory. This is due not only to the insufficiency of material, but also to the apparent lack of distinctive structural features even between taxa accepted as full species. Moreover, little or nothing is known of the factors (environmental and climatic) responsible for producing slight modifications of structure or the development of a particular colour design. All *Cordulegaster* are evidently very susceptible to the influence of climate and elevation and, like *Calopteryx* among the Zygoptera, prone to a considerable amount of individual colour variation in almost any habitat. There still exist important gaps in our knowledge of the geographical-distribution of the various populations, these hiatuses preventing us from getting a clear idea of the apparent discontinuity of the distributional area of each form. As long as these gaps have not been filled and no better structural characters are found, all deductions so far published concerning the origin, evolution and affinity of the various members of the *C. boltoni* complex will remain hypothetical and useless.

This paper being merely of a faunistic nature, no attempt has been made to throw more light on any of the existing problems. Much unstudied material from interesting localities in southern Europe awaits careful investigation. The following information may be found useful as a preamble to the student and future reviser of the group.



*Cordulegaster boltoni immaculifrons* SELYS, 1850  
(fig. 18, ♂ and ♀, and 28).

Not regional. On account of the similarity of structure, general appearance, arrangement of yellow markings, as well as the undeniable existence of transitional forms in parts of its range, I have followed the authors in considering this form a subspecies of *boltoni*.

The individuals figuring under this name in E. SELYS's collection

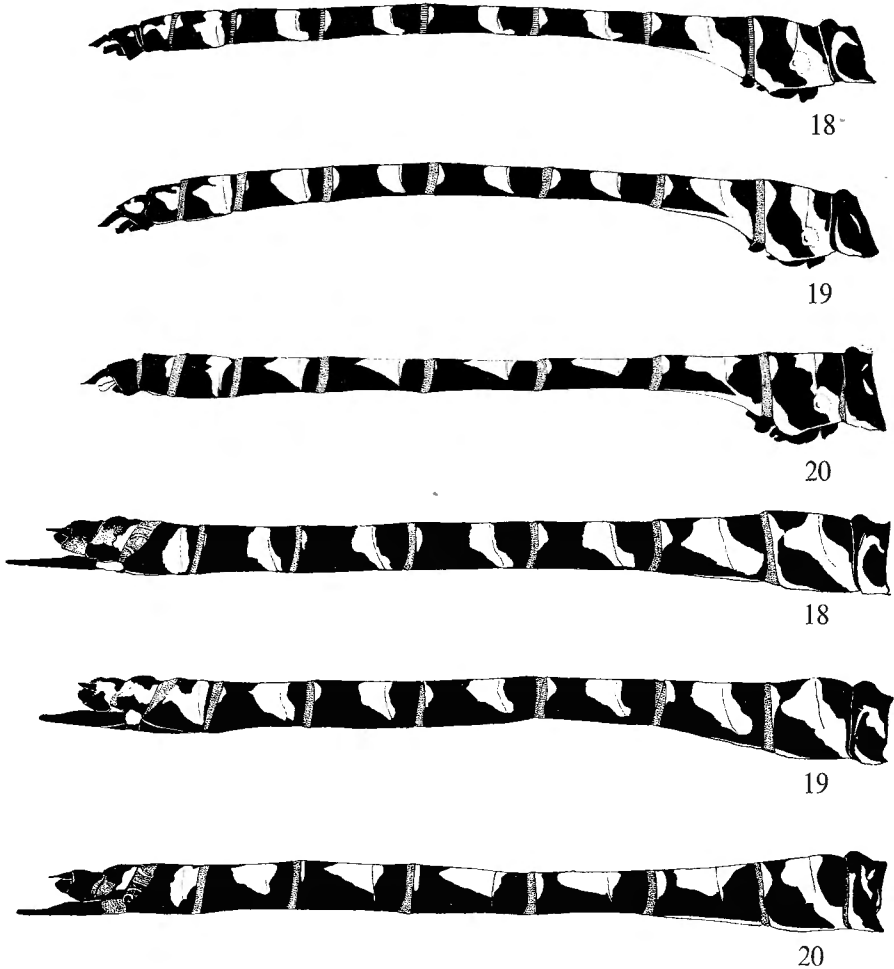


Fig. 18-20 : Abdomina of *Cordulegaster*, right lateral view; fig. 18, *C. boltoni immaculifrons* SELYS, ♂ from France (Drôme, Bourdeaux) and ♀ from France (Gard, Criu-lon near Quissac); fig. 19, *C. boltoni algiricus* MORTON, ♂ paratype from Algeria (Tlemcen) and ♀ from S. Spain (Andalusia, Ronda); fig. 20, *C. princeps* MORTON, ♂ from Morocco (Loc. 4) and ♀ from Morocco (Loc. 11). All figures on the same scale, drawn from enlarged photographs.

(IRSN) are a mixed lot originating from southern France, Italy and Sicily. Although the majority, if not all, were re-examined by R.J. TILLYARD and F.C. FRASER, they were unfortunately left in a confused state. Several specimens bear labels in F.C. FRASER's handwriting but a number of them do not correspond with the data supplied in his revision (1929). Clearly indicated localities on the labels of some are left unnoticed, while a number of identification labels were attached by FRASER to the wrong specimens.

The terra typica of *immaculifrons* was originally given by E. DE SELYS as « Midi de l'Europe ». The collection contains 6 males and 4 females which should, I believe, be considered as constituting the typical series; 4 males and 1 female are labelled « Mp » (for Montpellier), 2 males and 1 female « Fonsc. » (for BOYER DE FONSCOLOMBE), and 1 female « Ramb.» (for RAMBUR). In 1962 I selected one of the males labelled « Mp » as the lectotype, for this agrees with the plus variants mentioned in the original diagnosis, bearing moreover an identification label in E. SELYS's own handwriting. The same series included a male from Montpellier in the Leiden Museum that was presented by E. DE SELYS to his friend H. ALBARDA; this also is labelled *immaculifrons*. Leaving aside all remaining « *annulatus* » and « *immaculifrons* » in E. SELYS's collection originating from other districts in France and abroad, it can be said that true *immaculifrons* even in its restricted sense varies a great deal in the extent of yellow colouring on the terminal segments of abdomen. However, the essential characters (i.e. broad, complete or subinterrupted, median yellow rings on segm. 2-7, which separate it from *b. boltoni*), are present in all of them, thus agreeing with the two series A and B from Digne (Basses Alpes), dealt with and depicted by K.J. MORTON (1915). I have here illustrated the abdomen of a male from Bourdeaux (Drôme), collected by J. VAN DER VECHT; this corresponds with a profusely marked specimen of K.J. MORTON's series B as well as with the plus variants among the Montpellier population (fig. 18). Surprisingly, males in the Leiden Museum very similar to the last are from much higher altitudes in Central Spain : Sierra de Guadarrama, 1000-1400 m (Cercedilla and San Rafael, 14-18-VI-1958, R. STRAATMAN).

A female from Quissac, north of Montpellier, taken by myself, is here also figured (fig. 18). I have noted that the female ovipositor of *C. b. immaculifrons* from southern France is relatively longer, more gradually tapered, than in three females of *C. b. algiricus* from southern Spain (fig. 28). For further details, see under that subspecies.

### *Cordulegaster boltoni algiricus* MORTON, 1915.

(Fig. 19, 21-23 and 30.)

Material. — 1 ♂ (adult), labelled « Tanger » (blue, possibly ex Mus. Paris, R. MARTIN's writing ?), « *Cordulegaster annulatus* Latr. race

immaculifrons Selys », « Coll. Selys, Revision R. J. Tillyard » (printed museum label with R.J. TILLYARD's writing), and « *Cordulegaster annulatus algiricus* Morton, det. F. C. Fraser » (pink, F.C. FRASER's hand) (IRSN). 1 ♂ (adult), with two white printed labels « Tanger », « Coll. Camille Van Volxem », « 29 » and two written labels « *Cordulegaster annulatus* Latr. race *immaculifrons* Selys, determ. Selys » (R.J. TILLYARD's writing), and « *Cordulegaster annulatus algiricus* Morton ♂ det. F. C. Fraser » (pink, F. C. FRASER's hand) (IRSN). 5 ♂ 1 ♀ (partly defective), with « *C. immaculifrons*/Tanger » written on green labels, coll. R. MARTIN (MP).

Extralimital material. — 2 ♂ (adult), Algeria, Tlemcen, 14-VII-1904, and Sebdou, 29-VI-1904, M. E. FOUNTAINE; both with printed label « Morton Coll. 1940-1941 » and « Paratype » on yellow disks (ex coll. K.J. MORTON, RSM). 2 ♂ (adult), SW Spain, prov. Sevilla, Benamahonna (Cádiz) (5), 5-VII-1952, L. LOPEZ BANÚS (ex coll. M. BANÚS, ML). 3 ♀ (2 adult), S Spain, prov. Andalusia, Ronda, 5-VI-1955, R. STRAATMAN (ML). 1 ♂ (adult), S. Spain, prov. Malaga, Benalmadena, low country, 29-V-1962, C. A. W. JEEKEL and H. WIERING (MA).

Originally described from the province of Oran in Algeria, this is evidently the same dragonfly that was recorded already from Morocco many years previously by E. DE SELYS & H.A. HAGEN (1850), who mention Tanger (ex Mus. Paris) as a somewhat doubtful locality for the race *immaculifrons*. R. MACLACHLAN (1889) refers to two males, one taken at Gibraltar and a second on Benzus Bay at the opposite coast of Morocco, both being referred to the same variety. As a matter of fact, all North African *Cordulegaster* prior to K.J. MORTON's definition of *algiricus* passed for « race *immaculifrons* ». Further specimens from Morocco were examined by D. ST. QUENTIN (1952), who recorded 3 ♂ 2 ♀ from Taschdirt and Gondafa; these were correctly assigned to the present form under the name of *C. boltonii algiricus*, the whole series being lodged in the Vienna Museum.

Male. — Stature of *C. boltonii immaculifrons*, but distinguished therefrom by details of colouration that appear constant.

A comparison of the Spanish specimens with those from Tanger proves that they belong together, agreeing also perfectly with the two paratypes of *algiricus* and answering the description of K.J. MORTON's insect.

It will be observed that the abdominal spots are not only more extended

(5) These Spanish examples probably originate from the same area as those mentioned by COMPTE SART (1965), who gives « Sierra del Pinár, 1300 m », near Cádiz, as a habitat of his *C. annulatus immaculifrons* SEL. The two males referred to above were kindly presented to the Leiden Museum by Señ. M. BANÚS and COMPTE SART, the first named gentleman having shown them to me previously in his private collection at Palma (Mallorca) on the occasion of our visiting him and his family in May, 1958.

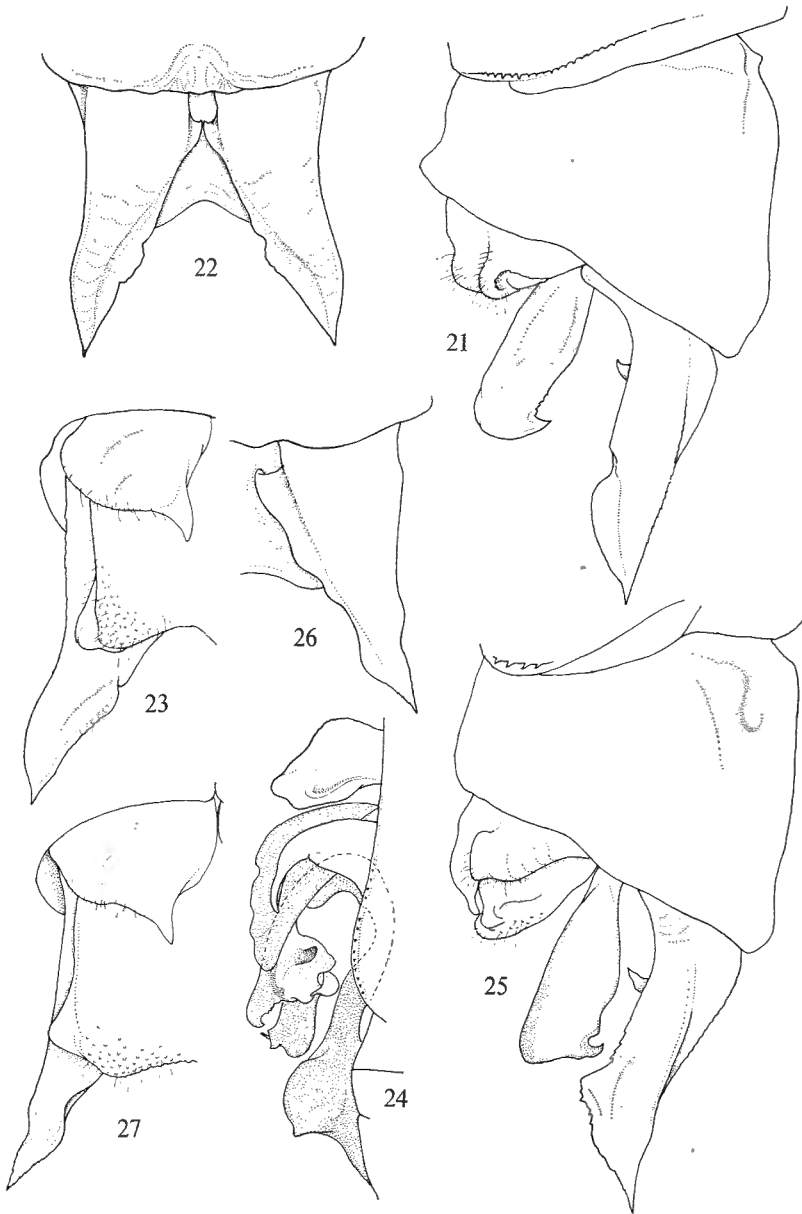


Fig. 21-23 : *Cordulegaster boltoni algiricus* MORTON, ♂ paratype from Algeria (Tlemcen); fig. 21, apex of abdomen, left lateral view; fig. 22, anal appendages, dorsal view; fig. 23, right half of anal appendages, ventral view. — Fig. 24-27 : *C. princeps* MORTON, ♂ from Morocco (Loc. 4); fig. 24, genitalia, left lateral view (penis and guard of penis stippled); fig. 25, apex of abdomen, left lateral view; fig. 26-27, right half of anal appendages, dorsal and ventral view.

(K.J. MORTON, loc. cit. pl. 35 fig. 5 and fig. 19 of the present paper) but also shaped differently. This is best appreciated in a lateral view : the bands on segm. 4-7 are not very oblique and angulated, surpassing the supplementary transverse sutures in a forward direction (as they do in *immaculifrons*), but abbreviated and leaving off abruptly at the sutures. These bands in dorsal aspect appear more convex behind on either side of the median line, at which point they are also more indented by black from behind. At the same time the bands on segm. 7 and 8 are noticeably larger than the preceding ones, the one on 8 bearing lateral prolongations almost or quite reaching the posterior border of segment. Lastly, segm. 9 and 10 are distinctly marked with a pair of irregularly shaped spots placed in the long axis of the segments. An additional and seemingly constant feature of *algiricus* is the presence on segm. 2 of a small, almost square, middorsal prominence of the black ground colour invading the transverse yellow band from behind.

The three males from southern Spain are almost exactly similar to our North African examples, except that in two of them a tiny black vestige is discernible just below the frontal crest. (6)

The anal appendages of a paratype from Tlemcen are shown in fig. 21-23.

*Female.* — Resembles the male in most respects but differs, of course, in the configuration of the yellow marks on the 2nd abdominal segment, the latter being very similar in shape and extent to those of female *immaculifrons*. With respect to colour, the main points by which *algiricus* can be distinguished from *immaculifrons* are (1) no traces of black at the dorsal crest of frons; (2) four small isolated spots at the metepisternum of thorax instead of a more or less obliterated stripe (widest dorsally) in *immaculifrons*; (3) more extensive yellow markings on abdomen, especially the very broad band around segm. 7 being quite characteristic. The abdomen of one of the Spanish examples is shown in fig. 19.

An interesting feature is the shortness of the lateral ovipositor valves in the Spanish examples (fig. 30). Although the material is scanty and no North African *algiricus* were available for direct comparison, the shape and length of this structure may afford additional characters separating this subspecies from *b. immaculifrons*. The length ratios between the lateral valves (measured from the postero-ventral angle of the 8th tergite) and segm. 9 + 10 (measured over the middorsal line) are as follows :

(6) As in *C. b. immaculifrons*, this last variation appears to be purely individual and not connected with any particular geographic area. Of the Gibraltar male recorded by R. MACLACHLAN, this writer says : « ...but there is an indication of the black transverse band at the top of the front ». Two males from Morocco in R. MARTIN'S collection (MP) also have traces of a black frontal line.

	Actual length (in mm)	Converted	Mean
<i>algericus</i> (Andalusia) ... ..	8.0 : 5.0	10 : 6.25	10 : 6.41
	7.6 : 5.0	10 : 6.58	
	7.5 : 4.8	10 : 6.40	
<i>immaculifrons</i> (S. France) ...	9.0 : 5.0	10 : 5.55	10 : 5.55
	9.0 : 5.0	10 : 5.55	
<i>princeps</i> (Morocco) ... ..	8.5 : 5.0	10 : 5.88	10 : 5.88

The differences will be best understood by reference to the outline sketches (fig. 28-30). It will be seen that the ovipositor of *boltoni algericus* from Spain — if it belongs here — has little similarity to that of *b. immaculifrons*, which is much more of the type of that of *princeps*. One may well ask, therefore, whether *algericus* should not be considered specifically distinct from *boltoni*.

There is much variation in size, the measurements (in mm) being :

	abd. + app.	hind wing
♂ Seb dou (Algeria) ... ..	57.7	43.5
♂ Tlemcen (Algeria) ... ..	57.9	44.2
♂ Tanger (Morocco) ... ..	59.5	48.2
♂ Tanger (Morocco) ... ..	56.0	45.0
♂ Cadiz (Spain) ... ..	60.0	45.5
♂ Cadiz (Spain) ... ..	54.0	43.7
♂ Benalmadena (Spain) ... ..	54.5	43.0
	abd. + ovip.	
♀ Ronda (Spain) ... ..	63.5	50.0
♀ Ronda (Spain) ... ..	59.0	49.0
♀ Ronda (Spain) ... ..	57.0	48.5

The Moroccan specimens in the Paris Museum were not measured.

### *Cordulegaster princeps* MORTON, 1915

(Fig. 20, 24-27, 29 and 31-32).

**Material.** — 1 ♂ (semiadult), 1 ♂ (freshly emerged, with exuvia) and 9 exuviae (2 ♂ 7 ♀), Loc. 4; 1 ♂ (adult), 1 ♀ (semiadult), Loc. 10, 1300 m, 1-VI-1966; ♂ observed also along small woodland stream above Azrou (Moyen Atlas), 1300 m, 22-V-1966, and at 6.30 p.m. flying over shaded road near El Ksiba (Moyen Atlas), 32 km E of Kasba-Tadla, 1150 m, 28-V-1966, author (all ML). Also 1 ♂ (juv.), Asni

(Haut Atlas, same as Loc. 10), 28-V-1953, G. L. SPOEK (ML); 1 ♂ (adult), Ifrane (Moyen Atlas), 1600 m, 15-16-VII-1934, A. BALL (IRSN); 2 ♂ (adult), Tizi-n-Test (Haut Atlas, route Taroudant), 1600 m, 26-VI-1934, A. BALL (IRSN). 3 ♂ 2 ♀ (all juvenile) and 3 exuviae, Ifrane (Moyen Atlas), 1700 m, 26-V-3-VI-1961, J. DORGELO (MA).

Published records of this fine insect from Morocco, sub *C. annulatus algiricus* MORTON, are from P. AGUESSE & J.P. PRUJA (1958a and 1958b), who gave Ifrane and Ras-el-Ma as localities. K.J. VALLE (1933) first recognized individuals from Azrou (Moyen Atlas) and Arround (Haut Atlas) as very distinct from *C. boltoni*, referring them to *C. princeps* MORTON instead. While discussing the *Cordulegaster* collected by the Finnish expedition in 1926, K.J. VALLE justly remarked that there is every likelihood of MORTON's *princeps* having come from North Africa and not from the Caucasus, as indicated. It is of interest to note that K.J. MORTON himself has placed his suspicion on record when he wrote: « Some time ago I received from Staudinger of Dresden a pair of *Cordulegaster* bearing the label « Tiflis Caucasus ». They rank among the finest of the *C. annulatus* group, and, supposing that 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. » (loc. cit. : 278).

In a recent memoir published by D. ST. QUENTIN (1952) the author refers to his correspondence with K.J. MORTON, early in 1939, about the status of *C. princeps*. Although K.J. MORTON in one of his letters again expressed doubt about the correctness of the locality labels, D. ST. QUENTIN preferred to leave the matter undecided and classified the insect as a subspecies of *boltoni*, as it stood before. However, soon after I had observed and collected some specimens myself, it became clear that K.J. VALLE was quite correct in considering *princeps* specifically distinct from *boltoni*. To make sure, I sent a pair of my short series to Dr. J. WATERSTON for confrontation with the types. This gentleman, to whom I am also indebted for the loan of two of K.J. MORTON's paratypes of *algiricus*, wrote to me as follows :

« There is no doubt that your specimens are *C. princeps* and that Morton was misled on the country of origin. The labels on both types are clearly printed Tiflis, Caucasus. MORTON's types also agree with Valle's figures. Both your specimens and Morton's differ from *algiricus* and *annulatus* in having the outer margin of the superior anal appendages straight and sharply pointed. In our *algiricus* the superior anal appendages are basally straight and then curve towards the tip making them outwardly slightly concave. » (in litt.)

The principal characters of this very distinct species may be summarised as follows :

Male and female. — More slenderly built than and superior in size to *C. boltoni* and its subspecies; yellow dorsal marks on intermediate segments of abdomen greatly extended but yellow spots on segm. 9 and 10 reduced or absent; rear of head almost entirely pale coloured.

Male. — Labrum yellow, only a hair-line or thin stripe at extreme base blackish, midbasal impression occasionally also somewhat obscured but never black. Anteclypeus brownish with yellow transverse streak bordering labrum. Postclypeus yellow with dark brown apical margin; impressions on each side of middle anteriorly at most ferruginous, never black. Frons divided into two parts by a strongly indicated, complete, rather W-shaped crest, the horizontal part deeply concave; colour entirely yellow save for a fine black line, slightly expanded medially, at extreme base. Occipital triangle strongly swollen, the squarish posterior area also convex; both yellow and surmounted with dense fringe of long yellow hairs. Rear of head light yellow with narrowly triangular black stripe, widest inwardly, running along upper part of eye-margin. Dorsal humeral spot of thorax vestigial or wanting. Mesinfraepisternum invariably with small yellow spot just below base of antehumeral band. Yellow line between lateral bands narrow, either entire or broken up into two or three spots, all above the spiracle; immediately below this lies a transverse yellow streak. Legs with short whitish keel at apex of anterior tibia, similar to that of *C. boltoni*.

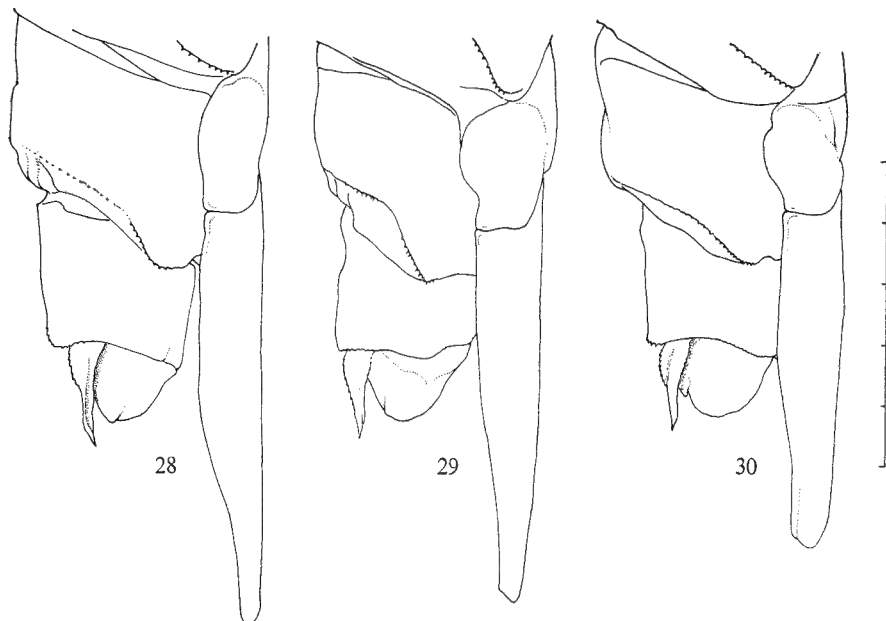


Fig. 28-30 : Apex of ♀ abdomen of *Cordulegaster*; fig. 28, *C. boltoni immaculifrons* SELYS, from France (Gard, Crieulon near Quissac); fig. 29, *C. princeps* MORTON, from Morocco (Loc. 11); fig. 30, *C. boltoni algericus* MORTON, from S. Spain (Andalusia, Ronda). Scale-line = 5 mm. -



Abdomen copiously marked with yellow, as shown by K.J. MORTON (1915), K.J. VALLE (1933) and in fig. 20. None of the elongate central spots on dorsum of segm. 3-7, even at their widest basal parts, extend so far down as to reach the lateroventral carinae; these marks taper rapidly caudad, where they are slightly indented by black in the median line. Segm. 8 with broad basal band almost roundabout tergite, 9 only with narrow transverse stripe at extreme base, usually interrupted medially so as to leave tiny streaks; 10 usually wholly black or, more rarely, with merest traces of yellow points at extreme base and/or apex.

Genitalia as in fig. 24. Anal appendages, superior pair subequal in length to segm. 10, colour black; inferior appendage more deeply emarginate than in *boltoni*, colour of its dorsal surface and sides conspicuously yellowish, even in old adults the sides remaining pale-coloured (fig. 25-27).

The length of the yellow dorsal spots on segm. 3-7 of the abdomen varies between individuals, whereas the amount of yellow on the basal and terminal segments remains constant. The transverse apical annules at the intermediate segments are small, usually vestigial on 5 and wanting on 6, but in one male from Tizi-n-Test the spots are united and in the form of a narrow transverse stripe discernible even on segm. 6 (see also MORTON, 1915, and VALLE, 1933).

*Female*. — Similar to the male; apart from the sexual characters differs only slightly in details of coloration and the greater length of the pterostigma. I have figured the abdomen and terminalia of the only specimen on hand (fig. 20 & 29).

Size very variable; measurements (in mm) are :

	abd. + app.	hind wing
♂ holotype (sec. MORTON) ... ..	59.0	46.5
♂ Azrou (sec. VALLE) ... ..	56.0	45.0
♂ Tizi-n-Test (IRSN) ... ..	62.5	48.5
♂ Tizi-n-Test (IRSN) ... ..	61.5	48.0
♂ Ifrane (IRSN) ... ..	64.5	48.7
♂ Ifrane (ML) ... ..	61.0	48.4
♂ Ifrane (ML) ... ..	63.5	48.2
♂ Asni (ML) ... ..	58.0	46.0
♀ allotype (sec. MORTON) ... ..	61.0	47.0
♀ Azrou and Arround (sec. VALLE) ...	60-63	49.5-52.5
♀ Asni (ML) ... ..	65.8	51.4

Other specimens are too immature to ensure reliable data.

The characters of *C. princeps* enumerated above are very striking at first glance. However, the alleged differences between « *annulatus* » and *princeps* observed by K. J. VALLE (i.e. shape of occiput and auricles, length of superior appendages relative to that of 10th abdominal segment, and breadth of wings), are unapparent in the present material.

The larval exuviae of *C. princeps* are very interesting (fig. 31-32).

The larva differs markedly from that of other described Old World species by having a short lateral spine only at the 9th abdominal segment, whereas in *boltoni* segm. 8 and 9 are each of them armed with a somewhat longer and more acuminate spine; in *C. bidentatus* and *insignis* both segments are entirely unarmed posteriorly (cf. K.F. BUCHHOLZ, 1954). The proportionate lengths of the antennal segments (fig 31) are almost as in *C. insignis*, also figured by K.F. BUCHHOLZ. The head of *C. princeps* is a little longer and distinctly less narrowed posteriorly, with less protuberant eyes, than in *boltoni*. On comparing the head drawings supplied by K.F. BUCHHOLZ (loc. cit.) for *C. insignis*, *boltoni* and *bidentatus*, the eyes of *princeps* in frontal view are much more broadly rounded than in *boltoni* (fig. 32).

I have failed to discover any difference in size or shape of the ovipositor valves between the exuviae of *boltoni* and *princeps*.

Although all exuviae were collected by me simultaneously in one locality within half an hour's time, they exhibit marked differences in size. Two males measure 45.0 and 47.2 mm for the body, 8.6 and 9.0 mm, respectively, across the eyes; females average slightly larger, their body length varying from 47.0-51.2 mm, the width over the eyes from 9.0-9.4 mm.

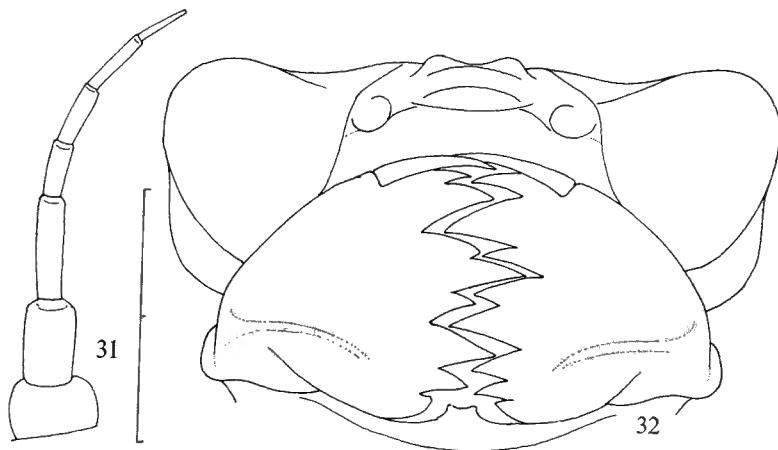


Fig. 31-32: *Cordulegaster princeps* MORTON, ♀ larval exuvia from Morocco (Loc. 4); fig. 31, right antenna; fig. 32, head in frontal view. Scale-line = 2 mm.

#### AESHNIDAE.

#### *Boyeria irene* (FONSCOLOMBE, 1838).

Material. — 1 ♂ 1 ♀, Loc. 8.

Also recorded by P. AGUESSE & J.P. PRUJA (1958) from Ifrane and Azrou. E. SCHMIDT (1965) obtained an almost full-grown larva from the Oued Tizguit, likewise at Ifrane (Loc. 4).

Our specimens (both slightly immature) were beaten up from the scrub vegetation bordering the small stream at Ouauouzarht, the female belonging to the most frequent (brachycercous) form.

Measurements are : ♂ abd. + app. 53.0 mm, hind wing 45.0 mm; ♀ 49.0 mm and 47.3 mm, respectively.

O.P. WENGER (1959) has published excellent drawings and photographs of the female genital organs and larva, taken from Spanish examples.

### *Aeshna mixta* LATREILLE, 1805.

K.J. VALLE (1933) reported this species from Azrou and Ras-el-Ma (Moyen Atlas), while P. AGUESSE & J.P. PRUJA (1958a) mention nearby Ifrane as a locality.

### *Aeshna affinis* VANDER LINDEN, 1823.

Recorded from Ifrane (Moyen Atlas) by P. AGUESSE & J.P. PRUJA (1958b).

### *Anax p. parthenope* SELYS, 1839.

**Material.** — 1 ♂, N. Morocco, ca 15 km S. of Ceuta, Restingas, sea level, 19-VIII-1964, H. H. BRONGERSMA (ML).

Recorded for the first time by P. AGUESSE & J.P. PRUJA (1958a) from Mader Bergat (Maroc saharien).

The specimen before me is slightly immature but in perfect condition.

Face and frons light chrome, the frons with the characteristic dark marks, which are brownish black on the vertical surface immediately below the crest, grey-blue behind the carina on the horizontal part. Dorsal surface of mesothorax light grey-brown slightly intermingled with pale green, laterally tinted a delicate pale bluish green becoming light ochreous lower down. Wings subhyaline, membrane with the usual pale saffronation most marked between nodus and pterostigma, the latter black or almost so. Membranula light grey, basally and at the apex white.

Abdomen, ground colour of segm. 1 entirely and of segm. 2 on the basal one-fourth as well as at the lower part of the sides, pale blue-green; all the rest of segm. 2 and 3-7 for their entire length, dark vinaceous grey; on segm. 8-10 the ground colour is again lighter, pale grey-blue, acquiring a light ochreous tint on segm. 10.

Anal appendages, superior pair brown, almost black at base and along dorsal crest; inferior appendix yellow, the strongly developed denticles black.

Measurements : abd. + app. 48.2 mm, hind wing 47.5 mm; sup. anal app. 5.4 mm.

The present example does not fit K.F. BUCHHOLZ's (1955) characterization of *A. parthenope geyri* BUCHHOLZ, described from Spain (terr. typ.), Mallorca and the Algerian Sahara. The anal appendages are shaped as in his fig. 4 for a male of *parthenope* from Brandenburg; the superiors in the present example are also much longer than in *geyri*, being in fact of the same great length as in specimens from Central Europe.

### *Anax imperator* LEACH, 1815.

**Material.** — 1 ♂ (adult), Loc. 8. Also 1 ♂ (adult), Khemisset, between Rabat and Meknès, 450 m, 26-VIII-1964, L. D. BRONGERSMA (ML). Widespread and apparently of common occurrence in suitable places, males being observed by me also in Loc. 1, 3, 4, 6, 13 and 14.

With regard to Morocco, there is one previous record of this species by R. MACLACHLAN (1889), who gives Esmir as a locality, and two others by P. AGUESSE & J.P. PRUJA (1958a and 1958b), who mention it from Merdja Bokka (Rharb) and Rabat.

### *Hemianax ephippiger* (BURMEISTER, 1839).

**Material.** — 4 ♂, Morocco, Dar Chtouka, and 1 ♀, id., Tolila, 26-II-1928 (MP).

Reported from Esmir by R. MACLACHLAN (1889), and from Marrakech, Goulmina and Assa by P. AGUESSE & J.P. PRUJA (1958a and 1958b).

### SUMMARY.

In the scattered literature on the Odonata of North Africa, the dragonflies of the extreme northwestern part of the continent have not been treated separately, up to this time. A review of the fauna of Morocco, based mainly on material in the museums at Brussels and Leiden, is herein presented as a preliminary to a more comprehensive account of the Odonata inhabiting all countries of the southern Mediterranean. As a result of the present study 50 species, pertaining to 26 genera in 9 families, have been found to occur in Morocco. These are discussed and where necessary critically analysed. All locality records published by earlier writers are incorporated in every instance. The list comprises 8 species not previously reported from the country and includes one new subspecies, *Gomphus simillimus maroccanus*. Illustrations and redescriptions are given of insufficiently known or misinterpreted taxa (genera *Calopteryx*, *Enallagma*, *Coenagrion*, *Ischnura*, *Paragomphus* and *Onychogomphus*), several of these being based on type material. The occurrence in Morocco of two species of *Cordulegaster* is definitely established, a characterization of the larva of *C. princeps* being also given. The Corduliid *Oxygastra curtisi*

(DALE) and the well-known migratory species *Libellula quadrimaculata* (adult and larval exuvia) are additions to the fauna of the African continent. The true Ethiopian element in the fauna is poorly represented. A map is included of the area visited by the author and a full bibliography of the regional Odonate fauna is given at the end of the paper.

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