pour un autre mâle qui se trouve aussi au Muséum de Vienne et qui provient du Montenegro : Durmitor, 2.000 m. alt., 20.VIII (Penther *leg.*). Ce dernier exemplaire porte l'étiquette « *S. rosellei* BÖTTCH. var. *novercoides* BÖTTCH. ».

C'est avec plaisir que nous dédions cette espèce à Mme Dr. Ruth LICHTENBERG (Vienne), qui nous a aidé à résoudre le statut de quelques espèces du genre *Bellieria* ROBINEAU-DESVOIDY.

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AN ANALYSIS OF THE ODONATA OF TUNISIA*

by Henri J. DUMONT**

SOMMAIRE

Quarante-cinq espèces d'Odonates sont connues avec certitude du territoire tunisien ; 8 ont été trouvées tellement près des frontières qu'il est raisonnable de les inclure dans la faune de ce pays. Quelques espèces supplémentaires sont probablement indigènes en Tunisie, et la faune odonatologique réelle de ce pays doit donc comporter environ 60 espèces. Aucune n'y est endémique, mais une fraction importante l'est de la zone Ibéro-Maghrebienne ou de la province Est de cette zone. En plus, il faut distinguer trois groupes de reliques pluviales : (1) des espèces d'Europe occidentale et centrale, à présent largement cantonnées dans les zones montagneuses ; (2) des reliques d'origine asiatique, présentes un peu partout, mais nettement concentrées dans les zones steppiques et sahariennes. *Sympetrum decoloratum sinaiticum* ssp. n. appartient à cette catégorie ; (3) quelques vraies reliques éthiopiennes, mais la majorité d'entre elles, numériquement importantes dans la faune tunisienne, sont soit des espèces migratrices, soit des espèces à très vaste répartition.

Nos connaissances actuelles des paléoclimats du Pleistocène nous permettent de dater toutes ces reliques de la dernière période pluviale, qui, en gros, date du Würm en Europe, mais il faut distinguer plusieurs périodes sub-pluviales postérieures, dont une durant le Néolithique, alors que le Mésolithique en Afrique du Nord était relativement sec. Il faut en plus tenir compte du fait

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que les variations des précipitations n'étaient ni synchrones ni d'égale amplitude dans le Maghreb et les territoires de l'Est et du Sud, à présent désertiques : Egypte, Levant et Sud Saharien.

Par conséquent, il est quasi certain qu'il y a eu de subtiles différences dans la période respective d'immigration des divers éléments cités plus haut. Ainsi, les quelques Anisoptères non migrateurs éthiopiens qui ont atteint la Sicile, la Calabre et la Sardaigne peuvent avoir profité du bas niveau eustatique de la Méditerrannée au maximum de Würm ; les éléments orientaux, qui n'ont pas atteint ces îles, sont probablement arrivés plus tard.

Certaines conclusions de cette étude dépassent le cadre tunisien. Ainsi, les zygoptères endémiques d'origine paléarctique, sont très étroitement liés à ceux de Sardaigne, de Sicile et du Sud italien, ce qui plaide en faveur d'un ancêtre commun qui a vécu au cours du Würm, et confirme la libre circulation par voie terrestre à travers la crête Nord-Sud de la Méditerranée centrale à cette époque.

L'absence de Zygoptères éthiopiens au Maghreb et leur rareté, jusqu'à présent, au Sahara central semble indiquer que la dernière période pluviale qui permit à des *Ischnura* du Maghreb de descendre jusqu'au Hoggar, n'était pas synchrone avec la période humide correspondant dans le sud au dernier haut niveau du Lac Tchad.

INTRODUCTION

Unlike Morocco and Algeria, Tunisia has been neglected by Odonatologists. Since LE ROI (1915) reviewed the fauna of this country, overlooking a reference by GADEAU DE KERVILLE (1908), no noteworthy additions were recorded. This is particularly surprising, since several aspects of the freshwater fauna of Tunisia have been studied by GAUTHIER (1928) and SEURAT (1938). Only the former author collected dragonflies, studied by LACROIX (1925). AGUESSE (1968) gives a list of 56 dragonfly species from Tunisia. It is clear that a number of species were included because they are known from Morocco or Algeria. This is a dangerous procedure, and even an objectionable one if not duely explicited. Indeed, some of AGUESSE's data are very improbable. On the other hand, this author seems to have neglected the entire odonatological literature on Libya, and therefore, some species that were to be expected in Tunisia (and have partly been found there by me) are omitted from his book.

The date which form the backbone of this paper were collected by me between march 22 - april 3rd 1976 and May 30th - June 11th 1976 ; a few dragonfly specimens had been taken much earlier, during a field trip in Tunisia in July 1962.

LIST OF LOCALITIES (fig. 1)

Loc. 1. Shallow pond at Bou-Kornine, ca. 10 m E. of Tunis, along the main road Tunis-Sousse, 31.V.1976.
Loc. 2. Shallow pond at Menzel Bou Zelfa, 9.VI.1976.
Loc. 3. Oued el Abiod, at its intersection with the road Soliman-Cap Bon, 9.VI.1976.
Loc. 4. Oued at Menzel Heurr, 9.VI.1976.
Loc. 5. Oued Rmel, 3 km. N. of Bou Ficha, in salt-marsh, 31.V.1976.
Loc. 6. Polluted Oued at Hammam-Sousse, ca. 5 km N. of Sousse, 31.V. 1976.
Loc. 7. Pool near Sbikha, 9.VI.1976.
Loc. 8. Barrage Kebir, 9.VI.1976.
Loc. 9. Oued el Kebir at El Fahs, 10.VI.1976.
Loc. 10. Oued el Hatab at its intersection with the main road between Kasserine and El Kef, ca. 15 km NW of Kasserine, 6.VI.1976.
Loc. 11. Brooklet at Thala (alt. 1070 m), 6.VI.1976.
Loc. 12. Oued Sarrath at its intersection with the main road between Kasserine and El Kef. ca. 35 m S of El Kef, 6.VI.1976.
Loc. 13. Spring and pond at the foot of Barrage Mellègue, 1.IV.1976 and 6.VI.1976.
Loc. 14. Oued Ghezala (= Rhezala), ca. 20 km N. of Jendouba, 30.III.1976 and 6.VI.1976.
Loc. 15. Barrage Beni Metir, near Aïn Draham, 30.III.1976 and 6.VI.1976.
Loc. 16. Oued Kebir, 8 km S. of Tabarca, 7.VI.1976.
Loc. 17. Pond, 8 km E. of Tabarca, 7.VI.1976.
Loc. 18. Brook in swampy meadow at Nefza, 7.VI.1976.
Loc. 19. Woodlands and small oued meandering through the local garrigue near Sidi Mecherig, 7.VI.1976.
Loc. 20. Oued Nefza, 10 km S. of Cap Serrat, 7.VI.1976.
Loc. 21. Oued Sedjenane, 15 km W. of Teskraia. 8.VI.1976.
Loc. 22. Swamps at the northern edge of saline Garaet Ichkeul, 8.VI.1976.
Loc. 23. Pond at Tindja, 8.VI.1976.
Loc. 24. Mountain oasis of Midès and Tamerza (springs and oueds) : 28.III. 1976 and 5.VI.1976.
Loc. 25. Temporary lakelet in mountainous area, 12 km N. of Metlaoui, 5.VI.1976.
Loc. 26. Gafsa oasis : springs, irrigation ditches and canals, 6.VI.1976.
Loc. 27. Kriz : brooklet draining water from Kriz oasis into Chott el Djerid, 3.VI.1976.

Loc. 28. Tozeur oasis : irrigation ditches and pools, 22.III.1976, 5.VI.1976 and 28.VII.1962.
Loc. 29. Nefta oasis : irrigation ditches. 23.III.1976 and 5.VI.1976.
Loc. 30. Kebili oasis : artificial carp pond. 23.III.1976 and 5.VI.1976.

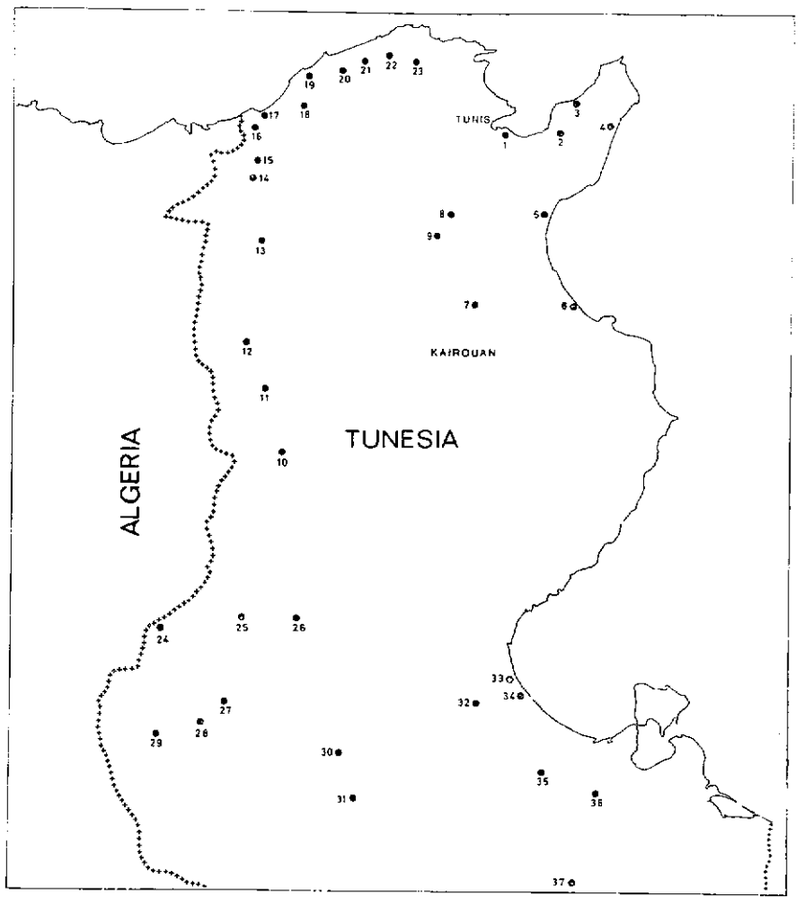


FIG. 1. — Locality map. Loc. 38 is outside the frame and it not shown.

Loc. 31. Douz oasis : irrigation ditches. 29.III.1976.
Loc. 32. Oued el Hamma at El Hamma de Gabès, 4.VI.1976.
Loc. 33. Small Oued at Aouinet de Gabès, ca. 15 km NE of Gabès, 1.VI. 1976.
Loc. 34. Chenini de Gabès (irrigation ditches) and Oued Gabès near Gabès City, 28.III.1976 and 1.VI.1976.

Loc. 35. Aïn Tounine : powerful freshwater spring and small oued on the road from Matmata to Medenine, 1.VI.1976.
Loc. 36. Remaining pools in the bed of Oued el Fedja at Metameur, 1.VI. 1976.
Loc. 37. Oued at Chenini de Foum Tatahouine, 1.VI.1976.
Loc. 38. Powerful spring at Decouk, between Foum Tatahouine and Remada, 2.VI.1976.

LIST OF SPECIES

1. *Calopteryx h. haemorrhoidalis* (VANDER LINDEN).
   Material examined : ♂♂, ♀♀, loc. 3, 4, 9, 14, 15, 16, 19.
   Previous records : Aïn Draham, 21.VII (MCLACHLAN, 1897) ; Aïn Draham, common at the Chabet el Touteia on June 10th 1906 (GADEAU DE KERVILLE, 1908) ; Aïn Draham, VI-VII (LE ROI, 1915).
   A common species in the Tell-Atlas, which is the limit of eastward extent of this taxon.

2. *Calopteryx exul* SÉLYS.
   Material examined : loc. 14, ♂.
   Previous records : none.
   An interesting discovery, which widens the range of this fine insect to the whole Atlas range. *C. exul* was once believed to be restricted to Algeria, until LIEFTINCK (1966) found it at Ifrane, Middle Atlas, Morocco. I found two males somewhat more to the East, at Midelt, Morocco in July 1971 (DUMONT, 1972), and a large number of specimens at the same spot (a headwater of the Oued Moulouya) in May 1975. *C. exul* is a true Maghrebic endemic.

3. *Sympecma fusca* (VANDER LINDEN)
   No new material.
   Previous records : « Tunisia » (SPAGNOLINI, 1877). Also included by AGUESSE (1968).

4. *Lestes barbarus* (FABRICIUS)
   Material examined : ♂, loc. 1.
   Previous record : Suttra (SPAGNOLINI).

5. *Lestes v. virens* (CHARPENTIER)
   Material examined : mass-emergence at loc. 16 (about 60 specimens collected).

Previous records : Aïn Draham, 21.VII (McLachlan, 1897) ; region of Aïn Draham, 6-9.VI.1906 and region of Tabarca, 26.V.1906 (Gadeau de Kerville, 1908).

6. *Lestes sponsa* (Hansemann)

No new material.

Previous record : Region of Aïn Draham, 6.VI.1906 (Gadeau de Kerville, 1908).

7. *Lestes v. viridis* (Vander Linden)

Material examined : ♂♂, ♀♀, loc. 2, 7, 13, 18, 23.

Previous record : « Tunisie » (Aguesse, 1968).

8. *Platycnemis subdilatata* Sélys.

Material examined : long series in both sexes, loc. 3, 4, 14, 15, 16, 19, 21.

Previous records : region of Tabarca, Oued el Amor, 26.V. 1906, « common » (Gadeau de Kerville, 1908).

This is the second Maghrebian endemic, wich is now morphologically and ecologically well-known (Lieftinck, 1966 ; Dumont, 1972).

From a taxonomical and chorological point of view, however, some problems remain. Indeed, except for the less flattened tibiae of the second and third pairs of legs, the pale ground colour of the male abdomen (white, with a faintest greenish-blue tinge), the peculiar light green-bluish ground colour of the thorax in the adult male and the « red phase » in the teneral female (dorsum of head and thorax), there are no differences with *P. pennipes* (Pallas), and it is evident that these differences are not strong and not structural. The chorological argument is therefore needed to reinforce the morphological one : *P. subdilatata* and *P. pennipes* are presently completely disjunct, with a gap across the whole Iberian peninsula. Doubtlessly, however, *pennipes* and *subdilatata* evolved from a common ancestor in a very recent past, and therefore the land connection between Tunisia and Sicily must be invoked. As is well known, at the height of each of the Pleistocene glaciations eustatic sea lowerings of amplitude 100-150 m. occurred, sufficient to bridge the distance between the Cap Bon peninsula and Sicily-Continental Italy and allow faunal exchange across this corridor. At present, only *P. pennipes* is said to occur in Italy (Conci & Nielsen, 1956). In 1863, Sélys gave the name *P. pecchioli* to a « variety » of *P. pennipes* received from Tuscany. It is described as morphologically identical to *P. pennipes,* with the usual bilineate markings on the dorsum of the abdominal segments, but with a white instead of a blue ground colour. It is of considerable interest to find out whether such forms indeed exist in Italy, what the shape of their tibiae is like, and if they co-habit with « blue » forms. They could be the last European remnants of the gene-pool that, in the south, gave rise to the Maghrebian *P. subdilatata.*

9. *Ischnura saharensis* (Aguesse) (fig. 2, 1-2 ; fig. 3, 4-6).

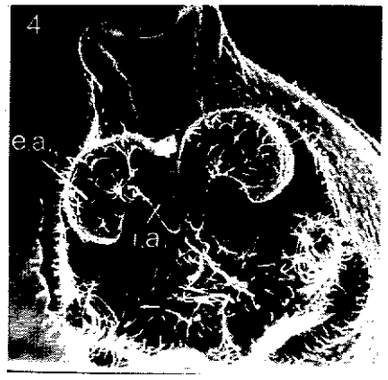
Material examined : long series, loc. 24, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38 always in the company and frequently outnumbered by *I. fountanei* Morton.

Previous records : *Ischnura* sp. recorded by Campion (1914) from Tozeur is either this species or *I. fountanei* ; Schmidt (1967) reports two males from Tozeur, 10.V.1913, leg. Schulthess ; Lacroix (1925) sub *I. graellsi,* gives reports from Médenine, Gafsa, Ajim Canal, O. Melah.

It is interesting to see that, like in Morocco, there is a rather sharp divide between the « northern » *I. graellsi* and the « southern » *I. saharensis* (and *fountanei*), coinciding with what is frequently accepted to be the northern boundary of the Sahara, i.e. the limit of the distribution of the palm-tree.

Such a spatial segregations should not be taken absolutely ; it is reasonable to expect « mixed » populations and more or less isolated colonies of either species in the domain of the others, especially in the boundary zone (see further).

I. saharensis is extremely close to *I. genei* (Rambur, 1842), and many earlier authors (Ris, 1911 ; Le Roi, 1915 ; Nielsen, 1935a) thought they were identical. It is now commonly accepted as a good species (Lieftinck, 1966 ; Schmidt, 1967 ; Dumont, 1972), but Schmidt's statement that it might form a transition between *genei* and *graellsi* is definitely not correct. In fig. 2, 1-2, the male terminalia of *saharensis* are shown in posterior view. It is impossible to separate these from *genei,* except that in the latter they are somewhat heavier built, as is the whole animal (no picture available). Fig. 2, 3 shows the terminalia of *I. elegans ebneri* Schmidt, the third west-palearctic *Ischnura* with crossed superior appendages. The latter are, however, closer to *I.e. elegans*



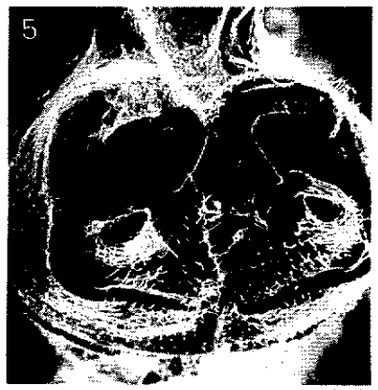


FIG. 2. — *Ischnura* sp. div., stereo-scan micrographs of male terminalia in posterior view : 1. *I. saharensis* (AGUESSE), general view of ultimate segments ; 2. the same, terminalia enlarged ; 3. *I. elegans ebneri* SCHMIDT ; 4. *I. elegans elegans* (VANDER LINDEN) ; 5. *I. graellsi* (RAMBUR) ; 6. *I. fountanei* MORTON.
(e.a. external arm, i.a. internal arm).

FIG. 3. — *Ischnura* sp. div., stereo-scan micrographs of female pronotum structures : 1. *I .genei* (RAMBUR), general view of pronotum and adjacent synthoracical area ; 2. the same, middle hindlobe of pronotum, dorsal view ; 3. the same, lateral view ; 4. *I. saharensis* (AGUESSE), hindlobe of pronotum, oblique dorsal view ; 5. the same, posterior view ; 6. the same, lateral view. (l.l. lateral lobe, c.l. central lobe, l.m. lamina mesostigmalis).

(VANDER LINDEN, 1820) than to the *genei-saharensis* group, as is clearly shown by fig. 2, 4. In the *I. elegans*-complex the external arm (e.a.) of the app. sup. is thick and swollen ; the inner arm (i.a.) is short and thin, of about the same length as the e.a. In the *I. genei-saharensis* group, the e.a. is less thickened and the i.a. is distinctly longer than the e.a. The angle between e.a. and i.a. is over 90° in *genei-saharensis,* under 90° in *elegans et subsp.*

I. graellsi (RAMBUR, 1842) offers a picture (fig. 2, 5), related to both preceding groups, but well different herefrom. The app. sup. is here distinctly horseshoe-shaped, and the tips of the internal arms are divergent. This form, a western vicariant to the *genei-saharensis group,* is a sideline in the development of the west-palaearctic *elegans*-group *sensu latissimo,* but does not provide a link between *I. elegans* and its North-African relatives. The true ancestor, as in *Platycnemis,* must again be looked for in an area that embraces Southern Italy, the late Pleistocene land bridge, and Central North Africa.

In this context it may be significant to attract attention to SCHMIDT's (1967) record of *I. elegans ebneri* from Calabria and the area of Brindisi. Forms from S. Italy with crossed superior appendages in the male have also been reported to me by C. NIELSEN (in litt.). The true identity of these populations should urgently be studied, preferably by means of Scanning Electron Microscope techniques as they probably hold a key position in the elucidation of the relationship *genei-saharensis* and *elegans.*

The extremely close relationship between *I. genei* and *I. saharensis* is also apparent in the females (fig. 3). Fig. 3, 1 gives an overall view of the female pronotum and adjacent mesothoracical area in *I. genei.* Fig. 3, 2 shows a detail of the mid-dorsal outgrowth of the posterior border of the pronotum. Unlike any other regional *Ischnura,* this outgrowth is of compound nature in the *genei-saharensis* group. It consists of two lateral lobes (l.l.), formed by the upper edge of the hind border's margin, and a central lobe (c.l.), formed by the lower edge of the hind margin. A lateral view of this situation is given in fig. 3, 3, which also features the lamina mesostigmalis (l.m.). Considerable variation does, however, exist in the relative proportions of the c.l. and l.l., and it is not rare to find a reduced central lobe, and two lateral lobes fused to an unpair, wide median lip.

This type of variability apparently does not occur in *I. saharensis.* Here, the lateral lobes (l.l.) are quite reduced, sometimes indistinct, while the central lobe is comparatively very strongly produced and dome-shaped (fig. 3, 4-5). In lateral view, it appears like a posteriorly bent tongue (fig. 3, 6).

10. *Ischnura graellsi* (RAMBUR) (fig. 2, 5).
Material examined : long series, loc. 3, 4, 5, 6, 9, 10, 11, 12, 13, 14, 15, 16, 18, 20, 21, 23.
Previous records : region of Aïn Draham 10.V-10.VI.1906 (GADEAU DE KERVILLE, 1908).

Considerable variation was observed in the extension of the bronze-black markings on the synthorax and the dorsum of the head. High-altitude populations, such as the one from Thala (loc. 11) had the antehumeral stripes completely obliterated and lacked postocular spots in both sexes. Lowland populations had well-marked blue or green antehumerals, but usually no postocular spots in the males.

11. *Ischnura fountanei* MORTON.
Material examined : long series, loc. 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37 38. A single male loc. 9.
Previous records : none with certainty.

This species, first described from Biskra, Algeria (MORTON, 1905) extends eastwards to the Middle East, including Iraq. In the Jordan Rift, it reaches Jericho. Its limit of westward extent is not precisely known, but is does not reach the Atlantic coast of North Africa (DUMONT, 1972, 1976). In South Tunisia, it is the most abundant dragonfly. The capture of an isolated male well inside the range of *I. graellsi* proves that the domains of the northern and southern *Ischnura* species should not be taken too rigorously. The specimen was spotted because it behaved peculiarly : it was, at the same time, conspicuously shy and agressive towards specimens of *I. graellsi* that approached it, and although the latter did not pay any particular attention to it.

The segregation between the two groups of Tunisian *Ischnura* is achieved by the presence of an arid zone characterized by the absence of surface water during summer. It extends between a line Kasserine-Sfax in the North and Gafsa-Gabès in the South. Local « pockets » of surface water may however persist in the hilly centre of this area, and it should further be borne in mind

that the present aridity of this area is due to overgrazing and ensuing increased erosion and came into existence during historical times. It is therefore not to be regarded as a valid geographical barreer. Future research should therefore look for ecological distributive factors.

12. *Cercion l. lindeni* (SÉLYS)
Material examined : series, loc. 1, 2, 3, 4, 5, 6, 9, 12, 13, 14, 15, 16, 19, 20, 21, 30, 32, 33, 37, 38.
Previous records : Aïn Draham, 21.VII (Mc LACHLAN, 1897) ; region of Aïn Draham, 9.VI.1906 (GADEAU DE KERVILLE, 1908).

13. *Coenagrion mercuriale* (CHARPENTIER)
Material : a short series in both sexes, loc. 11.
Previous record : Region of Aïn Draham, 13.VI.1906 (GADEAU DE KERVILLE, 1908).
Restricted to the higher altitudes of the Tell Atlas.

14. *Coenagrion puella* (LINNAEUS)
No new material.
Previous record : Region of Aïn Draham, 6-13.VI.1906 and Aïn Hameraia, 3.VI.1906 (GADEAU DE KERVILLE, 1908).

Specimens from North Africa were considered by SCHMIDT (1960) to represent ssp. *kocheri* ; the latter was considered a doubtful taxon by LIEFTINCK (1966).

15. *Coenagrion scitulum* (RAMBUR)
Material : ♂♂, ♀♀, loc. 1, 2, 3, 4, 11, 13, 15.
Previous record : region of Aïn Draham, 10.V-13.V.1906, common (GADEAU DE KERVILLE, 1908).

16. *Coenagrion caerulescens* (B. DE FONSCOLOMBE)
Material : ♂♂, ♀♀, loc. 9, 11, 24, 26, 28, 29, 30, 32, 33, 34, 37, 38.
Previous record : Aïn Draham, V (LE ROI, 1915) ; Médenine, X.1923, LACROIX (1925).

17. *Erythromma naias* (HANSEMANN)
No new material.
Previous records : Region of Aïn Draham, 13.VI.1906 (GADEAU DE KERVILLE, 1908) ; « Tunisie », V-VI (MARTIN, 1910).

18. *Ceriagrion tenellum nielseni* SCHMIDT.
Material : series, loc. 2, 4, 13, 18.
Previous record : Region of Aïn Draham, 6-13.VI.1906 (GADEAU DE KERVILLE, 1908).

19. *Gomphus lucasi* SÉLYS.
Material : loc. 4, ♀ ; loc. 14, 3 ♂ ; loc. 16, ♂ ; loc. 21, ♂.
Previous record : none, except if LE ROI's (1915) record was not *G. simillimus* as stated, but this species.

In colour pattern, *G. lucasi* is very closely related to the North African subspecies of *G. simillimus*, described by LIEFTINCK (1966). Yet, consistent structural differences separate both taxa without any doubt. The males are readily distinguished by the shape of their superior appendages (LIEFTINCK, 1966 ; AGUESSE, 1968), and comparative figures of the female valvules were given by DUMONT (1972). Of great diagnostic value in all *Gomphus* females is the structure of the vertex, more exactly the postocellar crest. Attempts at describing this structure were made by LIEFTINCK (1966), but words do not easily convey a visual message, and without the skill of an extremely gifted artist, it would be impossible to produce acceptable drawings likewise. Therefore, I turned to the technique of Scanning Electron Microscopy on uncoated specimens and the results are shown on fig. 4.

Fig. 4, 1 is a general view of the head of the female of *G. lucasi* from Menzel Heurr (loc. 4). The postocellar crest is shown, enlarged, in fig. 4, 2. Fig. 4, 3-4 show a female of *G. simillimus maroccanus* taken at Boulôjoul, Morocco. The differences between both are obvious : in *lucasi* the crest is a hollowed-out leaflet, slightly sinuous in front of the anterior ocellus, with lateral walls tilted but only very moderately thickened. The whole anterior and lateral margins are very distinctly produced over the ocelli. In *G. simillimus* (fig. 4, 3-4), the crest is not hollowed out in its central part, a little swollen in front of the anterior ocellus, but not produced over it. The lateral margins show a distinct hump on each side, which is produced backwards and confluent with the lateral ocellus.

Ethological note : Since very little is known about this insect, it seems worth while adding here a few observations made in the field. The flight period probably extends between March and June, depending for its beginning and end on the particular climatic conditions of the years. 1976 was characterized by a cold and

retarded spring, with heavy precipitations. Exuviae were found at the Oued Ghezala on 30.III.1976, but adults were clearly maturating away from the water. On 6.VI.1976, males were observed along the Oued. They showed territorial behaviour.

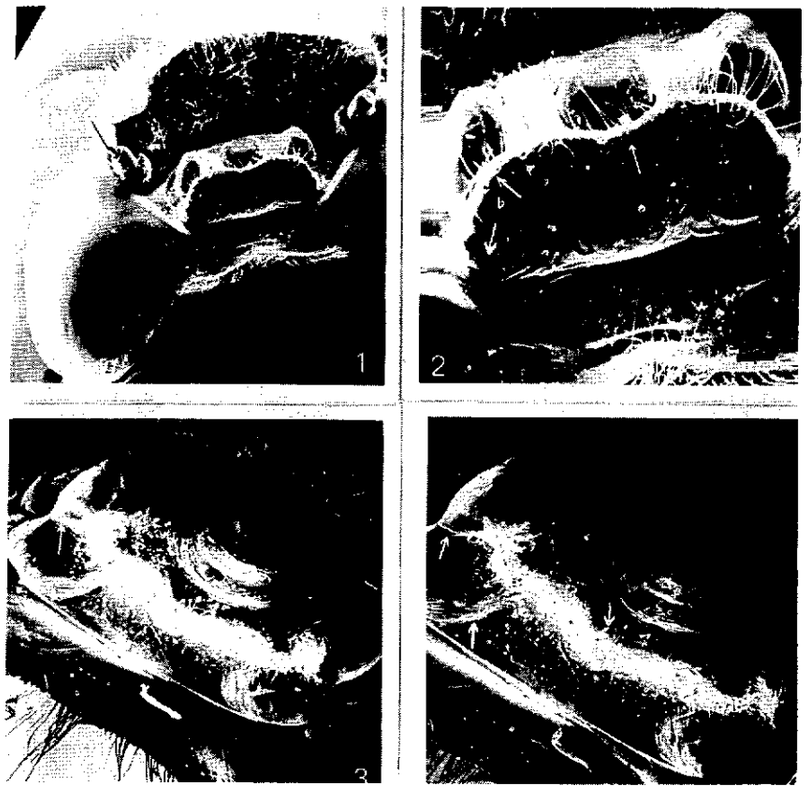


FIG. 4. — *Gomphus lucasi* SÉLYS, female, stereo-scan micrographs : 1. head, general view ; 2. detail of postocellar crest. *Gomphus simillimus maroccanus* LIEFTINCK ; 3.4. details of postocellar crest. Arrows indicate diagnostic details.

Territories were linear stretches of shoreline, between 20 and 30 m. in length, occurring in places where the current was held up and a reed girdle could develop ; only one side of the river seemed to be controlled by any one male. Perching sites were stones emergent from the water, or, more frequently, reed stems

hanging over the water. Males patrolled their territory at regular intervals, flying in a rather slow, rectilinear way at low altitude above the surface of the Oued. The ground colour of the thorax and the anterior two thirds of the abdomen are pale straw yellow, whereas the terminal widened segments of the abdomen are live citron yellow and very conspicuous. Although I did not find males and females together, I suspect that the male colour pattern serves as a first visual signal to the female. I have seen many *G. simillimus maroccanus* in many places in Morocco, but cannot remember having been struck by the same colour pattern in flying males. Therefore, this could be a clue by which both species effectively recognize each other, and arrive at co-habitation. MARTIN (1910) gives two localities in the area of Constantine, NE Algeria, where both co-occur : El Guerrah (about 30 km S of Constantine) and the Oued Seybouse (S. of Annaba and not so far from the Tunisian border). I did not observe any other Gomphid on the O. Ghezala, except *Onychogomphus forcipatus*. The latter was restricted to places where the current was swift, perching on stones along the river, and was thus spatially segregated from *G. lucasi*.

20. *Gomphus simillimus maroccanus* LIEFTINCK.
No material.
Previous record : Aïn Draham, V (LE ROI, 1915). This record needs confirmation, but, as stated above, is not at all improbable.

21. *Onychogomphus uncatus* (CHARPENTIER)
No material.
Previous record : area of Aïn Draham, 4-6.VI.1906 (GADEAU DE KERVILLE, 1908) ; the same record, but without precise locality was repeated by MARTIN, 1910 who had indentified GADEAU's animals and this was perhaps this author's sole source of information about Tunisian dragonflies.

22. *Onychogomphus forcipatus unguiculatus* (VANDER LINDEN)
Material : 3 ♂, 2 ♀, loc. 14.
Previous records : none, except Aguesse (1968).
The specimens agree well with material from Morocco.

23. *Onychogomphus lefebvrei* (RAMBUR)
New material : none.

Previous record : area of Aïn Draham, 4.VI.1906 (GADEAU DE KERVILLE, 1908) ; the same record, without locality, is also given by MARTIN, 1910. This author adds, be it with some doubts, two locality records from Algeria ; Biskra Oasis and Oued Rumel at Constantine, teneral females.

The presence of this species, common in the Middle East and Asia Minor, in North-Africa is quite interesting, since it can be used to support BODENHEIMER (1938) who claimed that in most animal groups of Northern Africa and even Southern Spain remnants are found of a former invasion of Asiatic origin. I shall return to this point later.

24. *Onychogomphus costae* SÉLYS.

New material : none.

Previous records : Tozeur, V (CAMPION, 1914). Also cited from « Tunisia » by LIEFTINCK (1966) and AGUESSE (1968).

24. *Paragomphus genei* (SÉLYS).

Material : 4 ♂, 2 ♀, loc. 28 (July 1962) ; loc. 29 (exuviae) ; loc. 31 (larvae) ; 3 ♂, loc. 34 ; 2 ♂, loc. 38.

Previous records : LIEFTINCK (1966) assigns to this species a couple, taken X.1923 by the limnologist H. GAUTHIER at Tozeur, identified as *Onychogomphus sp.* by LACROIX.

This is presumably the same material that was named *Onychogomphus pumilio* RAMB. in LACROIX (1925).

25. *Lindenia tetraphylla* (VANDER LINDEN)

No material available.

Previous records : none with certainty. AGUESSE (1968) includes this species, probably relying upon H. LUCAS' (1849) old record of three females taken by him at La Calle (El Kala), near Lac Oubeira, a locality which is very close to the Tunisian border and where, mainly during the last century, a series of very remarkable dragonfly species were collected. *L. tetraphylla* might also occur on lakelets along the Tunisian coast. The Nefza plain looks like a very promising study area.

26. *Boyeria irene* (B. DE FONSCOLOMBE)

Material : ♂, ♀, loc. 14 ; ♂, loc. 21.

Previous records : none with certainty. Included by AGUESSE (1968), presumably because of its occurrence in Algeria (MARTIN, 1901, 1910).

27. *Aeshna mixta* (LATREILLE)

Material : loc. 16, several specimens seen.

Previous records : Tunis (SPAGNOLINI, 1877) ; also known from several localities in Algeria, among which La Calle (SÉLYS, 1871).

28. *Aeshna affinis* (VANDER LINDEN)

Material : loc. 13, exuvia.

Previous records : several records from Algerian territory (area of La Calle) on the Tunisian border (SÉLYS, 1871 ; MCLACHLAN, 1897 ; MARTIN, 1910).

29. *Anaciaeschna isoceles* (MÜLLER)

Material : ♂, loc. 3.

No previous records, but the species has long been known from Algeria (MCLACHLAN, 1897).

30. *Anax imperator* LEACH.

Material : numerous specimens seen, loc. 1, 4, 9, 11, 13, 15, 20, 22, 25, 30, 32, 34, 37.

Previous records : Tunis (SPAGNOLINI, 1877) ; Oued Gabès, X.1923 (LACROIX, 1925).

A species widespread in Tunisia, but never seen together with the next.

31. *Anax p. parthenope* (SÉLYS)

Material : specimens at loc. 2, 5, 18, 24, 26, 27, 28, 29, 35, 36, 38.

Previous records : Carthago (SPAGNOLINI, 1877) ; Médenine, O. Gabès, O. Melah (LACROIX, 1925).

Widespread, though less common than *A. imperator*. Both occur in the same area, but are mutually exclusive in most biotopes ; the mechanisms regulating their habitat selection are still obscure.

32. *Hemianax ephippiger* (BURMEISTER)

Material : ♂, loc. 36.

Previous records : none.

33. *Cordulegaster boltoni algiricus* MORTON
Material : none.
Previous records : none. Since, however, this rheophilous species was found on mountain rivulets between Constantine and La Calle, it is almost certainly living in the Tunisian Tell Atlas as well. I halted at several small, typical *Cordulegaster*-streamlets in the surroundings of Aïn Draham, but could not find any exuviae nor see adults specimens. LE ROI (1915) gives VI-VII as flight period for this animal in Algeria (sub *C. annulatus immaculifrons*).

In view of the retarded summer of 1976, it is well conceivable that emergence had not yet started at the end of May.

34. *Orthetrum c. chrysostigma* (BURMEISTER)
Material : ♂♂, ♀♀, loc. 1, 2, 5, 6, 9, 10, 12, 14, 15, 18, 20, 24, 26, 27, 28, 29, 30, 32, 33, 34, 35, 36, 37, 38.
Previous records : ♂, Tozeur, V (CAMPION, 1914) ; Oued Adjun, ♂ (LACROIX, 1925).

A very successfull species, ranging throughout the Ethiopian area, and, as a distinct subspecies, also in the Oriental region. It is widespread in the Maghreb.

35. *Orthetrum nitidinerve* (SÉLYS)
Material : ♂♂, ♀♀, loc. 1, 2, 3, 9, 15, 18, 24 (extremely common), 26, 32, 33, 34, 35, 37, 38.
Previous records : Aïn Draham, 21.VII (MCLACHLAN, 1897); Gabès, X (LACROIX, 1925).

A quite common species, that is largely restricted to North Africa, but occurs on the Central Mediterranean Islands (the type stems from Sicily), and has been recorded once from Napels (CONSIGLIO, 1952). A type of geographical distribution like this was already met in *I. genei-saharensis* and *Platycnemis*. The explanation is, of course, the same as in these cases.

Colonies of *O. nitidinerve* have recently been found well inside the limits of the Sahara (cf loc. 38) (DUMONT, 1976).

36. *Orthetrum ramburi* (SÉLYS)
Matérial : ♂♂, ♀♀, loc. 1, 2, 3, 4, 7, 11, 12, 18, 24, 26, 28, 29, 30, 32, 33, 34, 36, 37, 38.
Previous records : Aïn Draham, VIII (SÉLYS, 1871) ; Aïn Draham, 21.VII (MCLACHLAN, 1897), all *sub O. anceps* (SCHNEIDER).

37. *Orthetrum b. brunneum* (B. DE FONSCOLOMBE)
Material : 2 ♂, loc. 38.
Previous records : none.

This is a significant record, well extending the known range of this insect to the South-East in Northern Africa, where it is considered to be rare on the whole. There is a record from North-West Algeria by RIS (1913) and a few precise localities are known from Morocco (LIEFTINCK, 1966 ; DUMONT, 1972). *O. brunneum* has also long been known from Sardegna (CONCI & NIELSEN, 1956).

38. *Orthetrum cancellatum* (LINNAEUS)
Material : ♂, loc. 1, 3 ; ♂, ♀, loc. 11, 13.
Previous records : none.

A species which, in North Africa, has not been found outside the Atlas range or the coastal areas in the immediate vicinity of this mountain chain. It was noted from the classical Algerian localities near the Tunisian border : La Calle, Lac Oubeira (MC LACHLAN, 1897).

39. *Orthetrum trinacria* (SÉLYS)
No new material.
Previous record : none from within the Tunisian borders. Algerian records from La Calle, Lake Tonga, Lake Oubeira (MCLACHLAN, 1897 ; MARTIN, 1910) on the one hand, from Benghasi in Libya (RIS, 1911) on the other hand, make its occurrence on Tunisian territory almost a certainty, as postulated by AGUESSE (1968).

O. trinacria is another Ethiopian species which may be used as evidence for the late Pleistocene land bridge over the Mediterranean. It was indeed first described from Sicily (SÉLYS, 1841) and was recently discovered in Sardegna (BUCCIARELLI, unpublished).

40. *Orthetrum sabina* (DRURY)

No material and no new records. AGUESSE (1968) does not include this species in the fauna of North Africa, although LE ROI (1915) gives a precise citation for a male taken at Temacin by GEYR VON SCHWEPPENBURG. The collector states to have seen more specimens on the wing at Temacin (near Touggourt), which is a small town not so far from the Tunisian border. Moreover, there is a record for this species from Giarabub oasis in Cyrenaica

(NAVAS, 1930), so that its occasional presence in Tunisia has about the same high probability as for the preceding one. *O. sabina* is an oriental species, widespread in Asia Minor and the Levant, and still common in Egypt (ANDRES, 1928).

41. *Acisoma panorpoides ascalaphoides* RAMBUR

No new material and no previous records, i.e. the situation of this species is the same as that of the two preceding ones.

Records are available from North-East Algeria : Lake Oubeira, (SÉLYS, 1871) and from Libya : Aïn Zarah, Endschila (RIS, 1911a). This is the second species omitted by AGUESSE (1968) from his Fauna of North Africa.

42. *Diplacodes lefebvrei* (RAMBUR)

Again, no new material and no previous records. Reports are available from La Calle and Lake Tonga, Algeria (SÉLYS, 1871) and from Gherran, Tripoli and Aïn Zarah in Libya (RIS, 1911a).

43. *Brachythemis leucosticta* (BURMEISTER)

No material and no previous records. This is the fifth species recorded only from the classical NE Algerian lowland lakes (SÉLYS, 1871 ; MCLACHLAN, 1897 ; MARTIN, 1910), where it is said to be abundant in summer. I know of no records from Libya, although this species is common in Egypt (ANDRES, 1928), and it extends westward to Morocco (AGUESSE & PRUJA, 1958 ; DUMONT, 1972), reaching Spain (COMPTE SART, 1965).

44. *Crocothemis e. erythraea* (BRULLÉ)

Material : common, loc. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 13, 15, 18, 20, 21, 24, 25, 26, 27, 28, 29, 30, 32, 33, 34, 35, 36, 37, 38.

Previous records : « Tunisia » (SPAGNOLINI, 1877) ; Tunis (SJÖSTEDT, 1899) ; Gafsa, X.1923 (LACROIX, 1925).

45. *Sympetrum s. striolatum* (CHARPENTIER)

Material : ♂♂, ♀♀, loc. 2, 3, 11, 15, 17, 18, 19, 20, 21, 24, 32, 34.

Previous records : Region of Aïn Draham, 6.VI.1906 (GADEAU DE KERVILLE, 1908).

46. *Sympetrum meridionale* (SÉLYS)

Material : ♂♂, ♀♀, loc. 2, 3, 11, 15, 17, 18, 19, 20, 21, 24, 32, 34.

Previous records : Tunis (SPAGNOLINI, 1877) ; area of Aïn Draham, 3.VI.1906 (GADEAU DE KERVILLE, 1908).

47. *Sympetrum fonscolombei* (SÉLYS)

Material : ♂♂, ♀♀, loc. 1, 3, 4, 7, 8, 9, 10, 12, 13, 14, 15, 16, 20 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38.

Previous record : Tunis (RIS, 1911).

48. *Sympetrum sanguineum* (MÜLLER)

No new material.

Previous records : Region of Aïn Draham, 6.VI.1906 and Region of Tabarca, near Oued el Amor, 26.V.1906 (GADEAU DE KERVILLE, 1908).

Also recorded (« common ») from the neighbouring NE-Algerian lakes Tonga and Oubeira (SÉLYS, 1871 ; MCLACHLAN, 1897).

49. *Sympetrum decoloratum sinaiticum* ssp. n. (fig. 5).

Material : 2 ♂, 2♀, loc. 28, all slightly immature.

Extralimital material : 2 ♀, one adult, one immature, Sinai Mountains, Mt Katherina, 1500 m, 13.II.1974 and Sinai Mountains, El-Arbain, 14.VII.1974, both F. KAPLAN leg.

Comparative material of nominal subspecies : a couple from Basra, Mesopotamia (now Iraq), ex. coll. K.J. MORTON.

Previous records : specimens pertaining to this taxon were recorded from what now becomes the type locality, Tozeur, by RIS (1916) and LACROIX (1925). Further, a series became available to LE ROI (1915) from several Algerian localities. Specimens were collected during II, III and V at Ouargla (not so far from Tozeur), Amgid, Oued Agelil, Ideles. A few years before, RIS (1911a) had published the first African record for *decoloratum* from the Tripolitanian localities Gherran, Endschila, Djebel T'kut, VII-IX.

Introductory remarks :

S. decoloratum is a little known dragonfly, which has probably not always been correctly differenciated from related congeners. It was described by SÉLYS (1884) at a time when even the specifity of *S. vulgatum* and *S. striolatum* was not yet fully established, and, therefore, it is only natural that Sélys' first ideas about this species were rather vague. At that time, too much diagnostic value was accorded to colour patterns in *Sympetrum,*

and, consequently, RIS (1911b) could show that part of Sélys' type material really belonged to other decolorate species, mostly *S. meridionale* according to SCHMIDT (1954). RIS (1911b) brought order and gave good figures of the male hamuli and female valvules. A very useful further diagnostic character in the male was supplied by BARTENEF (1919). Unlike many other *Sympetrum,*

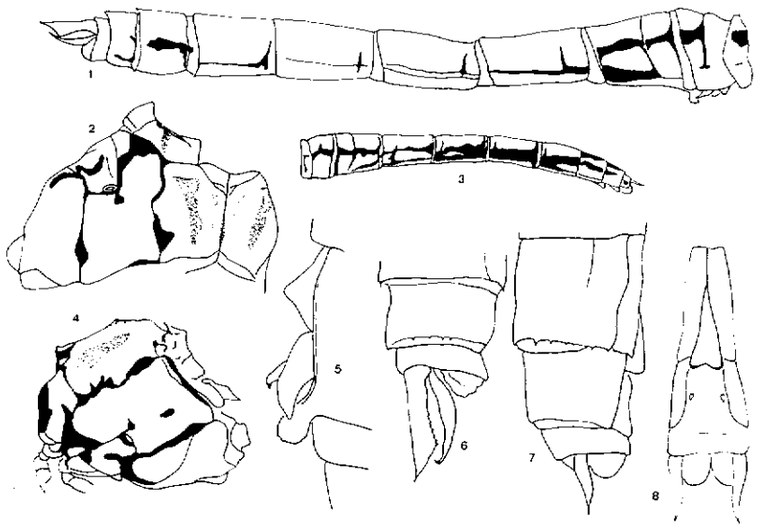


FIG. 5. — *Sympetrum decoloratum sinaiticum* ssp. n.: 1. male holotype Tozeur, abdomen; 2. synthoracical black markings of dito; 3. female Paratype, Sinai desert, abdomen; 4. synthoracical black markings of dito; 5. Holotype, hamuli, lateral view; 6. idem, terminalia; 7. female paratype, Tozeur, terminal abdominal segments, lateral view, showing valvules; 8. idem, ventral view.

and especially all other regional species (*vulgatum, striolatum, meridionale, fonscolombei, s. sanguineum*) the tip of the app. inf. reaches to halfway between the dentiform inferior angle of the app. sup. and the tip of the app. sup. (fig. 5, 6). Colour patterns should not be used in *Sympetrum* at the species level, but rather at the subspecies level and if accompanied by a well-defined geographical distribution pattern only. The type specimens from Asia Minor (and those before me from Basra, Iraq) are strikingly decolorate, but RIS (1911b) had already been

struck by darker forms from Quetta (Pakistan) and from Tripolitania (Libya). However, he thought that dark thoracic and abdominal markings were typical of teneral specimens, and would tend to disappear at maturity. He was followed herein by LE ROI (1915), although the reasoning of this author is not entirely clear. In fact, the black markings tend to disappear in all adult *Sympetrum* males, as the adult red colour develops, but not in females, which mostly remain either yellow or brown-red, and this also applies to the present new subspecies (which is salmon red as an adult, not live red as e.g. *S. sanguineum*).

For reasons unknown to me, this species is not at all referred to in AGUESSE's (1968) book, while it is in fact another example of Bodenheimer's Asiatic invasion fauna. It is not without interest to attract attention to RIS' (1911b) confirmation that a couple in Sélys' private collection from Catalonia is indeed *S. decoloratum*. If *S. decoloratum* exists in Spain, there is good reason to suppose that it is represented there by ssp. *sinaiticum nov.*, and that it has been (and still is) confused with *S. sanguineum*, which comes closest to it in colour pattern.

Description :

MALE :

Dimensions — Holotype* : total length : 35.5 mm ; abd. 24.5 ; hindwing : 27.0 ; — Paratype : t. 1. 36.0 ; abd. 24.0 ; hindwing 26.5. Structurally (hamuli, appendices) identical to nominal subspecies. Face yellow, frons somewhat darkened. Some black at the base of the vertex. Synthorax yellow, marked with black as in fig 5, 2. Adomen yellow, marked with black as in fig. 5, 1. No mid-dorsal black on S8 and S9. Tip of app. inf. black. Legs yellow, marked with black as follows : first pair with black streak on cranial side of femur, tibial spines black, tarsi black ; second pair idem, but flexor sides of legs entirely darkened ; third pair with cranial side of femur largely black, a black streak on the tibia ; tarsi entirely black, in addition to a whol darkened flexor side of the leg. Wings : venation dark brown, costa lighter, some amber at the base of all wings. Pt yellow (teneral). The

* Deposited at the Institut Royal des Sciences Naturelles, Brussels.

description is based on a teneral pair ; adults seen on the wing at Tozeur were salmon-coloured.

FEMALE :

Dimensions : Tozeur specimens : t. l. 36.0 and 34.0 ; abd. 24.0 and 25.0 ; hindwing : 26.5 and 25.0. — Sinai specimens : t.l. 34.0 and 34.0 ; adb. 23.0 and 23.0 ; hindwing 25.5 and 26.0.

Structurally identical to nominal subspecies, as far as the valvulae are concerned : these are little produced (fig. 5, 7), somewhat hollowed out at their extremity (fig. 5, 8). The synthorax is more heavily marked with black than in the male (fig. 5, 4) ; this is an adult specimen (Sinai) ; likewise, in the same specimen, the abdominal black markings are well expressed (fig. 5, 3) and a middorsal black bar is present on S8 and S9. The legs are, conversely, paler than in the male : the external side of all pairs is largely yellow ; only in the third pair is the flexor side black. The wings have basal amber, and the Pterostigma is brown.

50. *Trithemis annulata* (P. DE BEAUVAIS)

Material : ♂♂, ♀♀, loc. 1, 5, 14, 24, 26, 29, 30, 32, 33, 34, 38.

Previous records : V, Tozeur (CAMPION, 1914) ; X.1923, Gafsa (LACROIX, 1925).

51. *Trithemis arteriosa* (BURMEISTER)

Material : ♂♂, loc. 16, 19.

Previous records : none, except AGUESSE (1968).

52. *Rhyothemis semihyalina* (DÉSJARDINS)

No material and no previous records, except one occurrence on Lake Oubeira in NE Algeria (SÉLYS, 1871).

53. *Urothemis edwardsi* (SÉLYS)

Taken by LUCAS (1849) at Lake Oubeira, and described by SÉLYS (1849) on Algerian specimens. The true area of distribution of this animal is tropical Africa. No specimens are known from Tunisia, but its occurrence in the Nefza plain is not improbable.

The 53 species discussed above were not all actually taken on Tunisian territory ; the criterion used to include them was their joint occurrence in Algeria and Libya, or their presence in places not more than a few tens of kilometers remote from the Tunisian borders. A few others could also be cited, because living in both Morocco and Egypt, or in NW Algeria but not in Libya. I consider the probability of their presence in Tunisia as smaller than the first category, and therefore cite them separately.

They are :

54. *Calopteryx xanthostoma* (CHARPENTIER)

Known from Lambessa and El Guerra in Algeria (SÉLYS, 1871) ; no more recent data from North Africa available.

55. *Erythromma viridulum* (CHARPENTIER)

Widespread in the Middle-Atlas, Morocco (LIEFTINCK, 1966 ; DUMONT, 1972) ; also found in the Oued Seybouse-valley (MARTIN, 1910) in Algeria.

56. *Enallagma deserti* SÉLYS

Originally described from specimens taken in several locations in Algeria (Biskra, Lambessa, Constantine) ; common in the Middle-Atlas, Morocco (LIEFTINCK, 1966 ; DUMONT, 1972).

57. *Aeshna cyanea* (MÜLLER)

Recorded from the Moroccon Rif (El Biutz, 9.VI.1932) by NAVAS (1934) and from Algeria by LE ROI, 1915, and LACROIX (1925).

58. *Sympetrum depressiusculum* (SÉLYS)

MARTIN (1910) records three specimens from Lake Tonga, taken in July.

59. *Selysiothemis nigra* (VANDER LINDEN)

A good discussion of the distribution of this species is to be found in COMPTE SART (1960). The map on p. 82 clearly indicates that this species must sooner or later turn up in Tunesia. Pertinent records are : RIS (1913), El Golea (Algeria) ; KIMMINS (1950), Siwa Oasis in Western Egypt, and oases Koreishid, Tutnatee and Gara in Libya. VALLETTA (1949) took specimens in Malta, and CASTELLANI (1950), NIELSEN & CONCI (1951) and BUCCIARELLI (1971) established its presence in Sicily and South continental Italy.

AGUESSE (1968) lists in all 56 dragonfly species from Tunisia and some contained in his list are not included in the list of 59 given above. They are *Zygonyx torrida* (KIRBY, 1889) for which no records are available between Atlantic Morocco and The Levant ; *Pantala flavenscens* (FABRICIUS, 1798), a circumtropical migrant which, to the best of my knowledge has not been taken further North than Tamanrasset (KIMMINS, 1934) in the Hoggar mountains, Algeria, although it occurs in Egypt and The Levant. Still more doubtful are the Zygoptera *Calopteryx virgo meridionalis* SÉLYS, 1873 known only in two specimens from Algeria : Oran (SÉLYS, 1871) and Constantine (MARTIN, 1910) ; *Lestes macrostigma* (EVERSMANN, 1836) which, according to MARTIN (1910) should occur in Morocco, but no precise localities from that country are known ; finally, *Ischnura senegalensis*, RAMBUR, 1842, which has not been taken West of Benghasi, Libya (NAVAS, 1930), although it is common in Egypt (ANDRES, 1928).

CHOROLOGICAL SPECULATIONS

Because of important and repeated climatological changes during the Quarternary Epoch in North Africa, and in view of the recentness of large parts of the hyperarid areas of this part of the world, there is little logic in attempting a local faunal analysis based on present conditions only. There has been considerable progress made in the reconstruction of the Pleistocene climates of the Sahara since JOLEAUD's (1938) synthesis. COQUE (1962) in South-Central Tunisia and CHAVAILLON (1964) in the Oued Saoura area have shown independently the existence of five Pleistocene pluvials, the last of which was, grossly, coincident with the Würm glaciation in Europe. BUTZER (1971) provided an excellent synthesis of recent work. He shows that the last (the fifth) pluvial is really a pluvial complex, and that part of the 60,000 years of the Würm were certainly dry in North Africa. There were several humid periods, interrupted by arid or hyperarid intermezzo's. The most recent humid period coincided with the Neolithicum and ended somewhere in the middle of the second millenium B.P. The dragonfly fauna of North Africa, therefore *à forteriori* that of Tunisia, is heterogeneous : several types of elements may be recognized in it, and although there is no objective way of dating the age of each category, reasoning

will show that they did not all reach North Africa at the same date.

1. *The remnants of an endemic fauna*

The term endemic is preferred to « primitive », since the alternation of humid and dry periods during the Pleistocene brought destruction to pre-existing fauna's at several occasions. Therefore it is difficult to assign an age to these endemics, but since they are all at the species or subspecies level, the supposed oldest elements (*Calopteryx exul, Gomphus lucasi*) should be situated at the middle Pleistocene epoch at the most. Others (*Platycnemis subdilatata, Ischnura saharensis, Ceriagrion tenellum nielseni, Orthetrum nitidinerve*) were apparently, either themselves or a very nearly related ancestor, existing at the time of a land bridge across the Mediterranean. This bridge may only have been effective at the height of the Würm and was thus roughly contemporaneous with the fifth pluvial in North Africa.

Some mountain endemics (*Cordulegaster boltoni algiricus, Onychogomphus costae*) apparently did not cross the land bridge. The *Cordulegaster*-fauna of Sicily appears more nearly related to that of Asia Minor, and no *Cordulegaster* is known from Sardegna. All these endemics are of Western-Mediterranean origin, and, together with the fauna of the Iberian Peninsula, could be lumped to form an Ibero-Maghrebic sub-province of the Palaearctic realm. More typical elements of this area, to which the peculiar fauna of South-Western France is evidently related, are *Calopteryx haemorrhoidalis, Coenagrion c. caerulescens, Ischnura graellsi, Gomphus simillimus, Boyeria irene.*

2. *European pluvial relicts*

The North African mountain range has conserved a number of species which are of Western to Central European facies. Since they are relicts, they show little sign of speciation. An exception is *Enallagma deserti,* but as far as the Middle Atlas populations, which are the best studied, are concerned, this specific status is more a matter of convenience than anything else, since structural differences with *E. cyathigerum* are quite insignificant. Subspecific status has also been claimed for the local *Coenagrion puella* (ssp. *kocheri* SCHMIDT) and *C. mercuriale* (ssp. *hermeticum* SÉLYS), but this has not generally been agreed upon. Some species like

Pyrrhosoma nymphula (SULZER) appear to be larger in Morocco than in Western Europe, but this should be studied on long series. More examples of this group are *Sympecma fusca, Lestes sponsa, Erythromma naias, Onychogomphus uncatus* (doubtful), *Aeshna cyanea, Orthetrum cancellatum, Sympetrum depressiusculum. Libellula quadrimaculata* should also be cited here. This species was first recorded from Africa by SCHMIDT (1957) (Rif Mountains, Buhasen, 500 m, 12-15.VI.1954), and later found back in the Middle Atlas by LIEFTINCK (1966) and DUMONT (1972). In June 1975, I observed a dense population of this species on a lake let near the top of Col du Zad (slightly over 2000 m), Morocco, accompanied by a Zygopteran which could claim the same status, *Ischnura pumilio* (CHARPENTIER).

The use of the term relicts for these species may seem a bit unusual, since in many instances, their populations are not isolated from European ones. I give, in this paper, an almost etymological meaning to the term, i.e. I consider these populations as the shrinked remnants of populations which were doubtlessly wider distributed in North Africa at the height of the Würm.

3. *Ethiopian relicts*

All Ethiopian species known from North Africa, West of the meridian of, say, Benghasi and North of the Tropic of Cancer are Anisoptera. Zygoptera appear to be completely absent, and the Anisoptera show no sign of speciation. This suggests a mechanism of dispersal that could be described as a steeple-chase migration across a rather narrow desert barreer, and it applies to the following species : *Paragomphus genei, Trithemis annulata, T. arteriosa, T. kirby ardens* (not found in Tunisia), *Orthetrum trinacria, O. chrysostigma, Diplacodes lefebvrei, Brachythemis leucosticta, Acisoma panorpoides, Zygonyx torrida, Rhyothemis semihyalina, Urothemis edwardsi.* They support the views of some palaeoclimatologists, according to which at times of increased humidity in North Africa, large parts of the Southern Sahara and Sahel were at least as dry as to-day. A very significant fraction of this fauna appears to be restricted to some shallow, semi-permanent or permanent lakes in NE Algeria. They are not known to be migrants able to cross long distances devoid of lacustrine environments. Therefore, the possibility that Ethiopian Zygoptera occur in the Sahara but have been systematically overlooked by casual collectors should be taken seriously. From the

Central and Western Sahara, only *I. saharensis* is known (KIMMINS, 1934 ; REYMOND, 1952). It could take advantage of the Oued Saoura pathway. AGUESSE (1968), however, claims that MARTIN has cited *Pseudagrion torridum* from South Algeria and in Libya, the Italian explorer SCORTECCI, who seems to have collected dragonflies more systematically than anyone else in the Sahara, discovered *Pseudagrion acaciae* and *Agriocnemis sania* (*vide* NIELSEN, 1959). The latter, very closely allied to the Oriental *Agriocnemis pygmaea* (RAMBUR) (PINHEY, 1974, considers it as only a subspecies to the latter) is now known from the Upper Jordan valley (DUMONT, 1975) to Ethiopia (PINHEY, 1974). Caution and further study is thus required as far as an interpretation of the Ethiopian invasion fauna is concerned. Since part of it (*Paragomphus genei, Trithemis annulata, Orthetrum trinacria*) has crossed the Mediterranean and reached Sardegna and Sicily, it must have been present in North Africa during the earlier phase of the last pluvial complex ; the other species perhaps crossed the desert during the Neolithic pluvial phase.

What can be said with relative certainty is that the pluvial phases did not create an environment sufficiently rich in water to permit non-migrant, weak flyers (Zygoptera) to reach North, or that the continuity in surface waters did not last long enough.

4. *Asiatic elements*

This small category corresponds to BODENHEIMER's (1938) Irano-Turanian relict fauna, found in the Levant, but still in North Africa and the South of Spain. POR (1975) has recently criticized Bodenheimer's terminology, and it seems indeed better not to specify the origin of the species implicated further than to the Oriental level. Typical elements are *Onychogomphus lefebvrei, Orthetrum ramburi, O. sabina, Sympetrum decoloratum.* In the Central and Western Sahara occur two further representatives of this group : *Orthetrum ransonetti* and *O. taeniolatum.* A Zygopteran that perhaps belongs in this group is *Agriocnemis sania* NIELSEN, from Ghat oasis, Libya.

Since none of these species have crossed the Mediterranean land bridge, it is possible that they arrived in North Africa after the height of the Würm, i.e. during the Neolithic pluvial.

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EXCURSION ANNUELLE

Comme annoncé à l'assemblée générale du 9 janvier 1977, notre excursion annuelle se déroulera le dimanche 12 juin prochain dans les biotopes intéressants du Camp militaire d'Elsenborn.

Le rendez-vous est fixé à 10 heures au passage à niveau de Sourbrodt. Les personnes partant de Bruxelles ou y passant, se réuniront en face de l'Institut royal des Sciences Naturelles, rue Vautier 31, 1030 Bruxelles pour 8 heures au plus tard. Ils pourront prendre ceux qui n'ont pas de véhicules pour s'y rendre.

IL EST INDISPENSABLE DE S'INSCRIRE PAR AVANCE, car les autorités militaires exigent une liste complète de tous les participants et participantes [majeurs(es) comme mineurs(es)]. Veuillez donc envoyer votre réponse au secrétaire, à son adresse privée à Namur (rue des Croisiers 8, Bte 2). Dans la réponse, il faudra bien spécifier les nom et prénoms des personnes qui vous accompagneront ainsi que leur âge et leur adresse.

Votre réponse devra me parvenir pour le 24 mai 1977 au plus tard. Vous pouvez éventuellement aussi me téléphoner à mon domicile après 18 heures (081-22 47 65), soit à mon bureau à Gembloux (081-61 29 61 ou 61 29 66 ext. 22).

Il est évidemment indispensable de se munir de bottes, de vivres et de boissons pour le casse-croûte de midi.

C. Verstraeten.