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GENERIC RECLASSIFICATION OF SOME WESTPALAEARCTIC ODONATA TAXA IN VIEW OF THEIR NEARCTIC AFFINITIES (ANISOPTERA : GOMPHIDAE, LIBELLULIDAE)

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The nearctic affinities of 4 palaearctic spp. are pointed out and the following generic affiliations are suggested : *Tarnetrum fonscolombii* (for *Libellula Fonscolombii* Sélys, 1840), *Platetrum depressum* (for *Libellula depressa* Linnaeus, 1758), *Ladona (Eurothemis) fulva* (for *Libellula fulva* Müller, 1764) (all Libellulidae), and *Stylurus flavipes* (for *Aeschna flavipes* Charpentier, 1825) (Gomphidae). Consequently, *Libellula quadrimaculata* L. 1758 is the type species of *Libellula* Linnaeus, 1758 (fixation by Latreille, 1810), and *Plathemis* Hagen, 1861 becomes the nearctic subgenus of *Plathetrum* Newman, 1833 (type species : *Libellula depressa* L., 1758).

INTRODUCTION

Taxonomy work on Odonata commenced in Europe some 2 centuries ago (LINNAEUS : Uppsala ; MÜLLER : Copenhagen ; FABRICIUS : Kiel), and the current generic affiliation of some European taxa reflects the views held by the classical workers almost 100 years ago (HAGEN : Königsberg ; SÉLYS-LONGCHAMPS : Liège). At the end of the 19th century the center of taxonomic innovations in the Northern Hemisphere Odonata shifted to North America (incl. HAGEN), while in the past 50 years significant initiatives are also forthcoming from the Far East.

It is amazing that nearly no attempt has been made to update the generic classification of the European taxa in accordance with the modern understanding of various genera and their affinities, based on critical consideration of the non-European taxa. In the present paper, the consequences of such a procedure are pointed out for 3 examples, pertaining to the genera *Tarne-*

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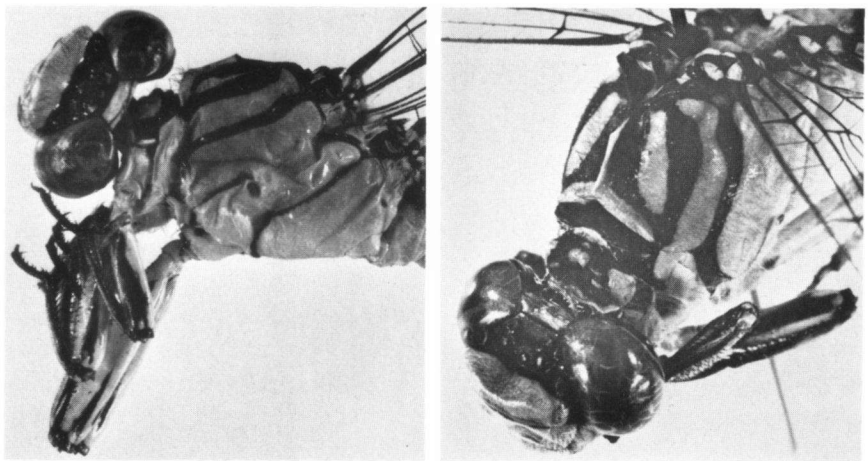
Figs 1-2. Thorax colour patterns of *Gomphus vulgatissimus* (L., 1758): – (1) 3-VI-1984, Berlin; – (2) 26-V-1975, near Kiel. Note the narrow yellow antehumeral stripe, interrupted at the mesinfraepisternum suture, and the U-shaped yellow pattern of front of synthorax (mesepisterna).



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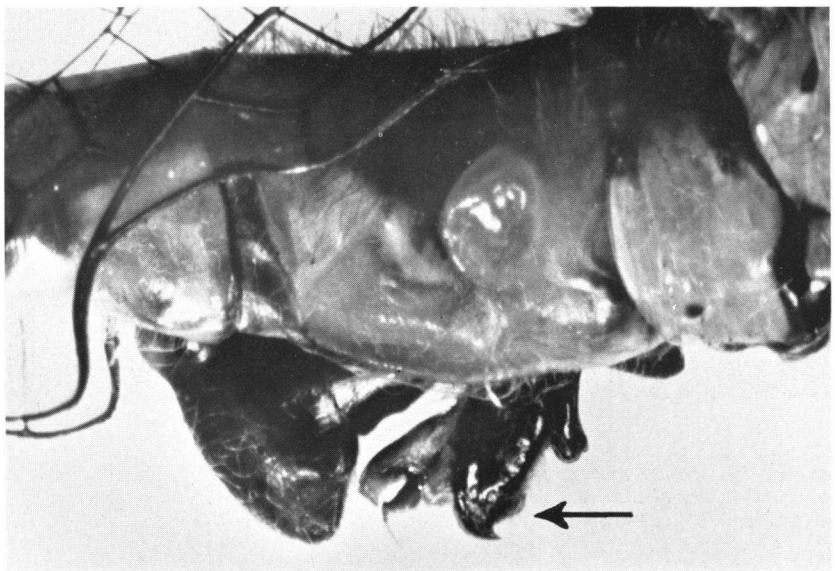
Figs 3-4. Thorax colour patterns of *Stylurus flavipes* (Charpentier, 1825), preserved specimen from River Spree, Germany. Note broad yellow antehumeral stripe running down to fore and middle legs, and the face-like yellow pattern of front of synthorax.



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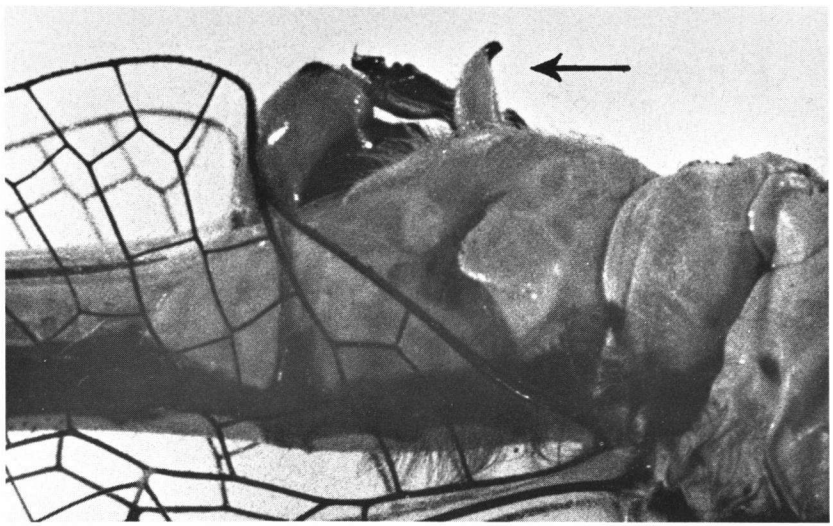

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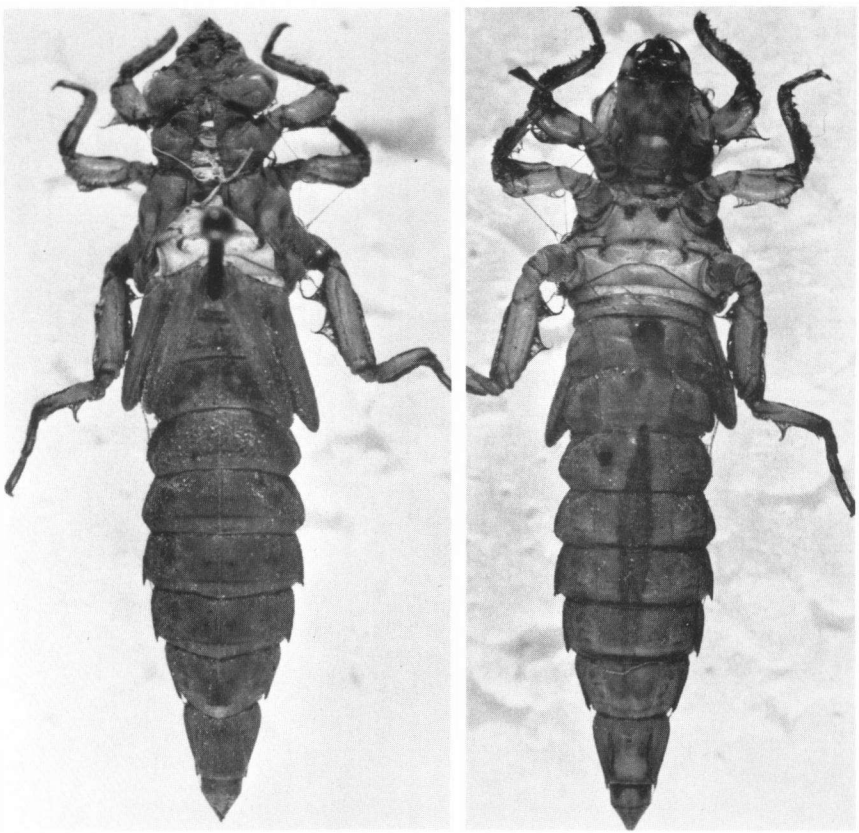
Figs 5-6. Male genitalia structures : – (5) *Gomphus vulgatissimus* ; – (6) *Stylurus flavipes.* The arrow indicates the posterior hamulus : compact and hooked in *Gomphus,* slender and acute in *Stylurus* (preserved specimens from Germany).

trum Needham & Fisher, 1936, *Libellula* L., 1758, and *Stylurus* Needham, 1879.

Subdivision on the generic or subgeneric level should be adopted whenever there occur convincing synapomorphies, and provided the reclassification enables clustering of imagines and of larvae under morphological, eco-ethological or biogeographic aspects.

TARNETRUM FONSCOLOMBII (SÉLYS, 1840) COMB. NOV.

The genus *Tarnetrum* was erected by NEEDHAM & FISHER (1936, type species *Mesothemis illota* Hagen, 1861). There exists some controversy on



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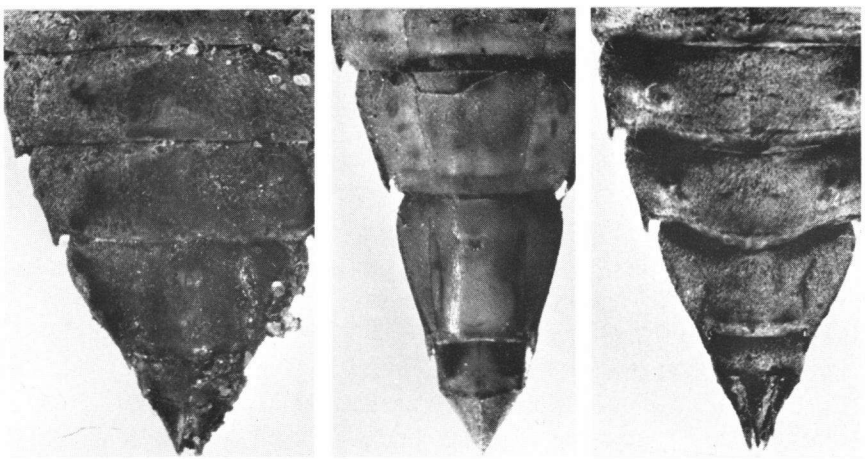
Figs 7-8. Exuvia of *Stylurus flavipes* (Italy, *Galletti leg.*) : – (7) dorsal view ; – (8) ventral view. Note the reduced burrowing spines of fore and middle tibia, the short hind femora, the slender abdomen with dept sections at segment borders, the reduced hair felt of the body.

characters and status (WRIGHT, 1946 ; NEEDHAM & WESTFALL, 1955 ; WALKER & CORBET, 1978 ; CANNINGS, 1982 ; DAVIES & TOBIN, 1985 ; TSUDA, 1986). The most important character seems to be the absence of middorsal spines and the reduction of lateral spines of the larva (WRIGHT, 1946 ; CANNINGS, 1982), which could also be of ecological importance. In Europe, *Sympetrum fonscolombii* (Sélys, 1840) is quite distinct from all other species of *Sympetrum* s.l. by this character (AGUESSE, 1968 ; CONCI & NIELSEN, 1956 ; CARCHINI, 1983 ; GARDNER, 1951 ; HAMMOND & MERRITT, 1983), and therefore this species should be regarded as the Westpalaearctic representative of the genus *Tarnetrum.* This is supported by other characters : *fonscolombii* is the only species here, with Southern distribution, being wide-spread over tropical Africa (CORBET, *et al.*, 1960 ; PINHEY, 1951, 1962), India (FRASER, 1936), Ceylon (LAIDLAW, 1924), and it is recorded from China (ASAHINA, 1949) ; it fits well with New World *Tarnetrum* by its thorax patterns, yellow wing markings, shape of the abdomen, male cerci and the male and female genitalia (d'AGUILAR *et al.*, 1985 ; ARCHER-LOCK, 1984 ; CONCI & NIELSEN, 1956 ; GEIJSKES & VAN TOL, 1983 ; NEEDHAM & WESTFALL, 1955 ; RIS, 1911 ; Eb. SCHMIDT, 1975, 1985 ; Er. SCHMIDT, 1929 ; WALKER & CORBET, 1978). Furthermore the species is a strong migrator (LONGFIELD, 1949 ; MOORE, 1956 ; MIELEWCZYK, 1982). In Central Europe and on the British Isles it breeds only temporarily, but in



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Figs 9-11. Tip of abdomen exuviae : — (9) *Gomphus vulgatissimus* ; — (10) *Stylurus flavipes* ; — (11) *Gomphus simillimus.* Note the elongated, nearly rectangular segment 9 in *Stylurus* instead of the rather short, trapezoid segment 9 in *Gomphus.*

contrast to *Sympetrum* s.str., it may have 2 generations with emergence in spring and in late summer/autumn (e.g. near Bonn at Zülpich 4-VI-1985 and 4-X-1985 resp.) ; the spring records are much earlier in the year than any record of a species of *Sympetrum* s.str. under comparable conditions. At the waterside the European form is quite distinct by its darting flight over the open, shallow water, and only scarce resting at the bank (Eb. SCHMIDT, 1982, 1985).

THE *LIBELLULA*-COMPLEX IN EUROPE

The genus *Libellula* Linnaeus, 1758 (RIS, 1910 ; WALKER & CORBET, 1978) is represented in Europe by 3 quite different species : *Libellula quadrimaculata* L., 1758 ; *L. depressa* L., 1758 ; and *L. fulva* Müller, 1764. They differ in essential characters of the body (including pruinescence and sexual dimorphism), of the genitalia and cerci, of the wing colour patterns and venation (dense, irregular last cross vein in *quadrimaculata*) in the imagines and of the larva (head shape, palpal crenulation, dorsal hooks), corresponding with different reproduction behaviour and habitat preference (GEIJSKES & VAN TOL, 1983 ; HAMMOND & MERRITT, 1983 ; ROBERT, 1959 ; RIS, 1910 ; Er. SCHMIDT, 1929). Indeed a separation on the genus level was already proposed 150 years ago (NEWMAN, 1833 : *Platetrum* for *depressa*, *Leptetrum* for *quadrimaculata*), but it has not been accepted by the great monographers (SÉLYS & HAGEN, 1850 ; RIS, 1910) and so was out of discussion in Europe, whilst in North America the establishment of *Plathemis* Hagen, 1861 (a name modification of *Platetrum* Newman ; type species *Libellula lydia* Drury, 1770), and of *Ladona* Needham, 1897 (type species *Libellula exusta* Say, 1839) are rather widely accepted at least as subgenera (NEEDHAM & WESTFALL, 1955 ; LEVINE, 1957 ; BENNEFIELD, 1965 ; but cf. WALKER & CORBET, 1978). Now *depressa* corresponds well with *Plathemis* (especially in the peculiar midventral processus of segment 1 in the males, the broad abdomen, and the larval characters), and *fulva* with *Ladona* (RIS, 1910, in spite of KENNEDY, 1922, based on penis morphology only) : so a separation at the genus level should be in order.

There are still some problems of nomenclatorial consequences. There is a contradiction concerning the type species of *Libellula* Linnaeus, 1758. Here we have to follow LATREILLE (1810), who selected *quadrimaculata* as type species of *Libellula* (RIS, 1916 ; COWLEY, 1935 ; CALVERT, 1956), instead of others (KIRBY, 1889, 1890 ; DAVIES, 1981 ; TSUDA, 1986 ; WALKER & CORBET, 1978), whose fixation of *depressa* thus is not valid.

Furthermore *quadrimaculata* is the only holarctic species, almost common and today well known everywhere under the genus *Libellula*; so the fixation of *quadrimaculata* as the type species of *Libellula* is the best from a practical point of view.

By separating the European species of *Libellula* s.l. at the genus level, the following taxa result:

Libellula Linnaeus, 1758. – Type species: *L. quadrimaculata* L., 1758.

Platetrum Newman, 1833. Type species *Libellula depressa* L., 1758. Subgenera: nominate subgenus palaearctic, including *Libellula melli* Schmidt, 1948 (China: Er. SCHMIDT, 1948); subgenus *Plathemis* Hagen, 1861 (nearctic; type species *Libellula lydia* Drury, 1770).

Ladona Needham, 1897. Type species *Libellula exusta* Say, 1839. Subgenera: nominate subgenus nearctic (sensu Needham & Westfall, 1955); subgenus *Eurothemis* Kennedy, 1922 (palaearctic; type species *Libellula fulva* Müller, 1764).

Thus the nomenclature of the three wide-spread European species becomes:

Libellula quadrimaculata Linnaeus, 1758
Platetrum depressum (Linnaeus, 1758)
Ladona (Eurothemis) fulva (Müller, 1764)

STYLURUS FLAVIPES (CHARPENTIER, 1825)

Definition and status of *Stylurus* Needham, 1897 (type species *Gomphus plagiatus* Sélys, 1854) have been subject of controversy (WILLIAMSON, 1932; NEEDHAM & WESTFALL, 1955). The genus rank is now accepted in East Asia (ASAHINA, 1976; CHAO, 1982; HAMADA & INOUE, 1985; ISHIDA, 1969; LIU, 1985; TSUDA, 1986) and usually also in North America (DAVIES & TOBIN, 1985). Doubts arose especially because of the Westpalaearctic *Aeshna flavipes* Charpentier, 1825 (Er. SCHMIDT, 1961; WALKER, 1957), which had been included in *Stylurus* by ASAHINA (1973) only. This was not followed in Europe (DAVIES & TOBIN, 1985).

Stylurus is quite distinct from other *Gomphus* s.l. by several characters of the imago and of the larva (NEEDHAM & WESTFALL, 1955; WALKER, 1957, 1958; WILLIAMSON, 1901). Generic distinctive characters are especially:

–1– Male genitalia: hamulus posterior simple, slender, acute

–2– Larva slender with segment 9 elongate, burrowing spines of fore and middle legs reduced.

These characters fit well with *flavipes* (Fig. 5-11 ; ASAHINA, 1973 ; CARCHINI, 1983 ; CONCI & NIELSEN, 1956 : including Fig. 134 (1) which erroneously is named *G. vulgatissimus* ; POPOVA, 1953 ; Er. SCHMIDT, 1929, 1936), as do the additional characters (shape of the abdomen, penis, male cerci ; female genitalia ; larval prementum, palpal tooth, reduction of hairs on the body). So there can be no doubt that *flavipes* is a true *Stylurus* and it confirms the generic status of *Stylurus*. Thus the species has to be named *Stylurus flavipes* (Charpentier, 1825). It is the Westpalaearctic representative of the genus, if we include *Stylurus lineatus* (Bartenef, 1929) = *S. ubadschii* (Schmidt, 1953) as a subspecies (DUMONT, 1977 ; cf. Er. SCHMIDT, 1953, 1954, 1961 ; ASAHINA, 1973). The records from Siberia (BELYSHEV, 1973) cannot be referred to this species, as seen from the original figures of male appendices and of the thorax patterns (BELYSHEV, 1973 : 467, fig. 186), which do not fit with *flavipes* and nor probably with any *Stylurus* species.

The larval characters of *Stylurus* seem to be an adaptation to life in soft sediments beneath the surface, allowing hunting for tubificids, chironomid- and *Ephemera*-larvae (MÜNCHBERG, 1932 ; POPOVA, 1953). *Stylurus flavipes* is restricted to sandy or muddy banks of rivers and streams (DONATH, 1985 ; ZIEBELL, 1982), including some artificial bank structures (by river dams : MÜNCHBERG, 1932).

Stylurus flavipes has a specific frontal colour pattern, which is quite different from European *Gomphus* species : in our *Gomphus* species the yellow middorsal stripes are very broad, widened at the base and confluent with the collar, thus looking like a U, framed at the sides by the black antehumeral and humeral stripes, which are close to each other and connected, at least at the base, with the mesinfraepisternum suture (Fig. 1-2 ; Eb. SCHMIDT, 1977, 1985). In *Stylurus flavipes* the middorsal black stripes are widened at the base and at the top, usually confluent with the antehumeral black stripe, thus separating the middorsal yellow stripe from the collar, resulting in a face-like frontal yellow thorax pattern (Fig. 3-4 ; BEUTLER, 1985 ; GALLETTI & RAVIZZA, 1977 ; STRAUB, 1951). Similar face-like frontal thorax patterns seem to be characteristic for many *Stylurus* species in the New World (GLOYD, 1936 ; WALKER, 1956 ; WILLIAMSON, 1932) as well as in the Far East (HAMADA & INOUE, 1985 ; ISHIDA & HAMADA, 1973 ; LIU, 1985). In *Stylurus flavipes* furthermore the dark antehumeral and humeral stripes are broadly separated by the yellow antehumeral stripe, which runs down to the mesocoxa without interruption (Fig. 3-4), quite different from our *Gomphus* species.

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