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Revealing the identity of some early described European Cixiidae (Hemiptera: Auchenorrhyncha) – a case of 'forensic' taxonomy; two new combinations and a name change for *Reptalus panzeri* in Britain

MICHAEL D. WEBB[1], ALEX J. RAMSAY[2] & VALÉRIE A. LEMAÎTRE[1]

[1] *Department of Entomology, The Natural History Museum, Cromwell Road, London SW7 5BD; e-mails: m.webb@nhm.ac.uk; v.lemaitre@nhm.ac.uk*

[2] *44 Sun Lane, Burley-in-Wharfedale, Ilkley, West Yorkshire LS29 7JB; e-mail: alexramsay6@yahoo.com*

WEBB M. D., RAMSAY A. J. & LEMAÎTRE V. A. 2013: Revealing the identity of some early described European Cixiidae (Hemiptera: Auchenorrhyncha) – a case of 'forensic' taxonomy; two new combinations and a name change for *Reptalus panzeri* in Britain. In: KMENT P., MALENOVSKÝ I. & KOLIBÁČ J. (eds.): Studies in Hemiptera in honour of Pavel Lauterer and Jaroslav L. Stehlík. *Acta Musei Moraviae, Scientiae biologicae* (Brno) **98(2):** 57–95. – Despite recent work on the identity of European Cixiidae, some anomalies have been found to remain. For example, just prior to this study, while identifying a British *Reptalus* Emeljanov, 1971 specimen we found it to match *R. panzeri* (Löw, 1883) in the British handbook, but also matched *R. quinquecostatus* (Dufour, 1833) of continental European authors. Further investigations revealed that the syntypes of Dufour's species matched neither of the above identifications but in fact matched the figures given by authors of *R. melanochaetus* (Fieber, 1876). These findings lead us to investigate how these and certain other early identifications of European Cixiidae had been made and how the British *Reptalus* species had remained misidentified for so long. During the course of the above work it was necessary to consult the historical literature relating to the above species and some of the more important articles are reproduced here, together with English translations for the first time. One of the studies consulted was FIEBER's (1875) 'The Cicadines of Europe' Part 1. In this work, Fieber noted he had figured in colour all the type specimens that he could examine but these are not to be found in Fieber's work. However, from an indication in the translator's Preface the figures were discovered in the Muséum national d'Histoire naturelle, Paris, where they had remained unreported since their acquisition. As a result of the above work we argue for the retention of the current identity of *Reptalus quinquecostatus* and *R. melanochaetus* in continental Europe and change the name for the British species *R. panzeri* to *R. quinquecostatus*, together with ecological and distributional notes on the latter and a revised key to separate the British genera of Cixiidae. In addition, the identities of two junior synonyms of *Pentastiridius leporinus* (Linnaeus, 1761) (*Flata pallens* Germar, 1821 and *F. pallida* Herrich-Schäffer, 1835), are also considered and resulting from a study of Fieber's figures, noted above, the male genitalia of *Reptalus limbatus* (Fieber, 1876) comb. nov., were found to be very similar to *R. venosus* (Rambur, 1840) comb. nov. Detailed figures of the former are given for the first time. From FIEBER's (1875) mention of the word 'type', noted in the current work, we take the opportunity to document the history of the 'type concept' and the earliest usage of the word 'type' (see Appendix 13).

Keywords. Fulgoromorpha, nomenclature, taxonomy, type concept, key to British Cixiidae

"Many of the [cixiid] *species are exceedingly like each other, and this has led to great confusion. Authors have not known what to do with them, and so they have been separated by one, put together by another, and finally mixed up almost indiscriminately."*

SCOTT (1870)

Introduction

The planthopper family Cixiidae comprises approximately 146 genera and 2000 species worldwide (HOLZINGER *et al*. 2002); thus the family is one of the largest in the Fulgoromorpha (Hemiptera: Auchenorrhyncha). Some members of the family are notable for their subterranean nymphs and the wax they and the adults produce (Plate 1). Also, as mainly phloem feeders, the sap-sucking habit of the group makes them potential vectors of phloem-inhabiting plant pathogens and indeed several European species are known virus vectors while some species of *Reptalus*, treated here, are potential vectors of Phytoplasmas (BERTIN *et al*, 2010).

Although found mainly in the tropics, the first species descriptions were mainly of European species. However, these early descriptions were so imprecise that each could 'fit' more than one species, although in some cases locality data may prove helpful (as for example with the identity of the earliest described European cixiids, *Pentastiridius leporinus* (Linnaeus, 1761) (see Results). Therefore, the 'true' identity of early described species can be unclear when their original descriptions lack certain diagnostic features that are in current use. This problem is compounded when type specimens are either unknown or are difficult to identify due to the absence of data in the original description and/or on the specimens. Also, in the absence of any early type concept any extant type material may also lack type identification labels.

Few nineteenth century authors in the Hemiptera: Auchenorrhyncha referred to borrowed type material when identifying species. Such trafficking of material might have been more difficult than today, particularly as specimens were more frequently in private hands, prior to being placed in institutions. Nonetheless, for some major revisionary works, e.g. FIEBER (1875, 1876, 1878, 1879) and MELICHAR (1896), types were borrowed, referred to in the former case as either the 'type' or 'original' material (see below). For other authors, if comparative original (type) material was not at their disposal, only brief published original descriptions could be relied on for identifications. Nowadays, when confronted with a similar situation an entomologist usually has little choice than to follow historical perceptions and a consensus of opinion in the literature on the identity of a given species. This course of action results in stability, at least until a missing putative type is found that contradicts the accepted view.

As with most Auchenorrhyncha, the identity of most cixiids is now based predominantly on characters of the male genitalia, however these characters were not generally used in early descriptions or were described but not figured, e.g. FIEBER (1876). It is unsurprising therefore, that this fact, together with unavailable type specimens and the large literature for some species (e.g., there are nearly 100 references to *Pentastiridius leporinus* from 1761 to 1929, in METCALF's (1936) catalogue), has given rise to many misidentifications in the literature of this group.

The problem of misidentifications in the literature was recognised early when SCOTT (1870) commentated on the confusion of British Cixiidae (see above quote on title page). Scott went on to say that the male styles serve as a "great guide" for identification, but although this proved to be the case, such characters only serve to distinguish species, not to apply the name, and in this instance Scott, like other authors (before and after), got some of the names wrong (see below).

The separation of European Cixiidae genera has frequently been based on the number of keels on the mesononotum. For example, Le Quesne & Payne (1981), in their checklist of the British Auchenorrhyncha, recognise 12 Cixiidae species placed in two genera, *Cixius* Latreille, 1804 and *Oliarus* Stål, 1862, based on the presence of three or five 'scutellum' keels, respectively. These British species are currently placed in five genera of which only two (*Pentastiridius* Kirschbaum, 1868 and *Reptalus* Emeljanov, 1971) have five keels. Each of these genera comprises a single British species, but the identity of these two species was confused in the early literature in both Britain and Continental Europe, a situation that we have found still exists today.



Plate 1. Subterranean immature of *Reptalus panzeri* (Löw, 1833). Image provided by Gernot Kunz.

During routine identification work on a British *Reptalus* specimen (Ramsay 2009) it was found to match the figures of *R. panzeri* (Löw, 1883) in the British handbook (Le Quesne 1960), but also matched the figures of *R. quinquecostatus* (Dufour, 1833) given by continental authors (e.g. Holzinger *et al.* 2003). In order to check which identification was correct we borrowed the syntypes of Dufour's species housed in the Muséum national d'Histoire naturelle, Paris. Much to our surprise we found that the types matched neither of the above identifications but in fact matched the figures given by authors of *R. melanochaetus* (Fieber, 1876)! These findings led to further investigations to establish how certain early identifications of European Cixiidae had been made and how the British *Reptalus* species had remained misidentified for so long.

In the current study we detail the history of some early described European Cixiidae, e.g., *Reptalus panzeri*, *R. quinquecostatus*, *R. melanochaetus* and *Pentastiridius leporinus* and two junior synonyms of *P. leporinus* (*Flata pallens* Germar and *Flata pallida* Herrich-Schäffer, 1835), and make reference to original early works, together with English translations for the first time (see Appendices 1–8).

Following the discovery that the type series of *R. quinquecostatus* is *R. melanochaetus* of authors and that the British *R. panzeri* is the same as *R. quinquecostatus* of continental authors, we provide notes and figures on the types of the former (see Appendix 9) and argue for the retention of the current identity of these two species in continental Europe.

Resulting from our translation of the introduction of Fieber's (1875–79) 'The Cicadines of Europe' his unpublished figures from this work were found in the Muséum national d'Histoire naturelle, Paris. These figures include the external male genitalia of *Reptalus limbatus* (Fieber, 1876) comb. nov., which are found to be very similar to *R. venosus* (Rambur, 1840) comb. nov. Detailed figures of the former are given here for the first time (see Appendix 10).

A revised key to the genera of British Cixiidae and figures of the two British *Reptalus* species are given (see Appendix 11) together with a brief summary of the European distribution and notes on the ecology of *R. quinquecostatus* (of authors) (see Appendix 12).

Lastly, Fieber's (1875) early mention of the word 'type' (see the list of his borrowed material, Appendix 7a) prompted us to research the history of the 'type concept' and the earliest usage of the word 'type'. As we found this subject to be poorly documented we give the results of this work in Appendix 13.

Material and methods

The following abbreviations are used throughout the text:

BMNH . . . . . The Natural History Museum, London, United Kingdom
MNHN . . . . . Muséum national d'Histoire naturelle, Paris, France
ZML . . . . . Zoological Museum Lemburg, Lvov, Ukraine

Historical account of some early misidentified European Cixiidae

Confusion with respect to the identity of some European cixiid species, including the two British *Reptalus* species, can be traced back to a misidentification of one of the first described European cixiids, *Pentastiridius leporinus*. This species, described as *Cicada leporina* from Sweden, was described after its fluffy (hare-like) wax tail, a characteristic of nymphs and females in this group (Linnaeus 1761, see Plate 1 and Figs 11a, 11c).

A subsequent reference to *C. leporina* was given by Panzer (1799) who gave a short extract from Linnaeus's description (Appendix 1) and figured the species for the first time (Fig. 1). His illustration matched the details given by Linnaeus, particularly its fluffy tail and showed a specimen with a short crown, a detail that would be of later significance.

Some-time later, Herrich-Schäffer (1835) described the cixiid *Flata pallida* (locality unknown) (Appendix 2), and stated in 1837 that his species differed from *C. leporina* in having a narrower head and in 1838 figured a variety with such a head (Herrich-Schäffer 1835–1840; Fig. 2). These actions made it possible for Scott (1870, in key) to describe the two British cixiid species with five scutellar keels as *Cixius leporinus* (with 'crown transverse') and *C. pallidus* (with 'crown longer than broad').

Fieber (1876) undertook a complete revision of the entire European Auchenorrhyncha fauna (see Appendix 3), during which time he placed and redescribed several cixiids (with five scutellar keels) in *Oliarus*, including *O. leporinus* auctt., *O.*

pallidus and *O. quinquecostatus* (described by Dufour 1833 as *Cixius quinquecostatus*) and also described a new species, *Oliarus melanochaetus* (see Appendices 4 and 5).

The acceptance of Panzer's (1799) concept of *leporinus,* by the above authors, was eventually questioned by Löw (1883) (see Appendix 6), using the works of two Finnish authors. Firstly from Sahlberg (1871) he learned that Herrich-Schäffer's description of *F. pallida* matched that of Linnaeus's Swedish *C. leporina* and that the *C. leporina* of authors (with a short crown) was not to be found anywhere in Scandinavia. Secondly, from Reuter (1880), Löw understood that Herrich-Schäffer's *pallidus* is the only species of *Oliarus* (with five scutellar keels) present in the whole of Scandinavia. He therefore concludes that *leporina* and *pallidus* are the same species and that the *leporina* of other authors requires a new name. For this purpose, Löw chose the name *panzeri*, after the man who has first figured it, Panzer (1799).

In Britain, Edwards (1894) followed Löw's (1883) work and changed the name of the British *pallidus* to *leporina* and *leporina* to *panzeri*. This change was subsequently followed by Le Quesne (1960), who figured their male genitalia. However, although Le Quesne (1960) used the name *panzeri* he also noted (p. 8) that it did not match Dlabola's concept of it (presumably Dlabola 1952 and 1954 figures) and therefore the name of the British species might have to change.

Results

As noted above (see Introduction), the discovery that British *Reptalus* specimens matched the figures of *panzeri* in Le Quesne's (1960) British handbook, but also matched the figures of *Oliarus/Reptalus quinquecostatus* given by continental authors, led us to consider the identities of these two species and this led to further discoveries from the pertinent historical literature. The results of these findings are as follows.

Pentastiridius leporinus, *P. pallens* and *P. pallidus*

With respect to *P. leporinus* there has been no disagreement as to its identity in recent times (see Fig. 11a). However, only a fragment of the type remains in the Linnaean collection, London, so there is no possibility of confirming its identity.

The recent synonymy of *Flata pallens* Germar, 1821 and *Flata pallida* Herrich-Schäffer, 1835 with *Pentastiridius leporinus*, e.g., Holzinger *et al*. (2003), could not be confirmed as the whereabouts of the type material of the latter is unknown and the type of the former is missing its genitalia; in this group the male genitalia are needed for confirmation of species identity (see Emeljanov 1979). *Oliarus pallens* (Germar), is treated as a good species in Metcalf's (1936) catalogue with *Flata pallida* Herrich-Schäffer as its junior synonym, however, if the former is a valid species then it would be a junior homonym of *Flata pallida* Say, 1830. The original descriptions of *F. pallida* and *F. pallens* are provided (Appendices 2 and 7 respectively), together with an image of the type of *F. pallens* (Fig. 7b). From this and other images of the type of *F. pallida* seen the five mesonotal keels and large number of spines on the apex of the first hind tarsomere indicate its correct placement in *Pentastiridius* (see key in Holzinger 2003: 70, and

Appendix 11) . It should be noted that Metcalf (1936) lists Taurus Mts (Turkey) for the type locality of *Flata pallens* Germar but the original description says Tauria which is in Crimea, Ukraine.

Reptalus panzeri

As noted above, Löw (1883), in establishing *Oliarus panzeri*, was merely renaming what he considered to be the misidentified *C. leporina* Linnaeus of previous authors and the name he chose was for the 'discoverer' of the species, Panzer (1799). Therefore, it could be argued that the original Panzer specimen(s) should be regarded as the type material, but Panzer's collection has not been found (Horn *et al*. 1990). Although only three of the five fine mesonotal keels, associated with *Reptalus* species (including *panzeri* auctt.), are shown in Panzer's figure (see Fig. 1), the current identity of *panzeri*, first figured by Dlabola (1952, 1954) and more recently by Bertin *et al*. (2010), based on male genitalia of non-type material, is upheld.

Reptalus melanochaetus

In describing *Oliarus melanochaetus*, Fieber (1876) had only female specimens obtained from Southern France 'Montpellier, received under the name *Fulgora leporina*'and Southern Russia 'Sarepta (Frey-Gessner)'. It was distinguished from its congeners externally by its dark tuberculate setae of the forewing veins and hence the origin of its name (see Appendices 4 and 5). A female specimen from Sarepta has been found in the Paris museum (MNHN, Lethierry-Nouhalier collection) (pers. com. by Gernot Kunz) which could be one of the types. In the absence of evidence to the contrary, the identity of this species given by Logvinenko (1975) and subsequent authors is here supported.

Reptalus quinquecostatus

With respect to *Cixius quinquecostatus* Dufour, 1833, there are three specimens standing under this name in Dufour's collection (MNHN) and as these do not disagree with the original description they are regarded as putative types (see Appendices 8 and 9). Examination of the genitalia of the male specimen for the first time (Figs 9c, d) reveals its identity not to be *R. quinquecostatus auctt.*, as supposed, but identical to *R. melanochaetus* (Fieber, 1876), *sensu* Logvinenko (1975) and subsequent authors. The other two specimens could be the same species as the syntype male but the tubercle spines of the forewing, which are dark in this species, are rubbed off.

Reptalus limbatus* and *R. venosus

Resulting from our discovery, during the current work, of Fieber's unpublished figures of his 'Cicadines of Europe' (Fieber 1875–79) the figures of *Oliarus limbatus* Fieber (Fig. 5d) were found to be similar to those of *Cixius venosus* Rambur, 1840 given by Webb (1979: Figs 50–55). This similarity was confirmed by examination of the type

specimens of *C. venosus* (BMNH), with contemporary specimens identified as *O. limbatus* (MNHN, Puton collection) by Gernot Kunz and Hannelore Hoch who also kindly supplied the figures reproduced here (Appendix 10). The original type data for *O. limbatus*: 'Male. 6.5 mm. Body 5 mm. Andalusia, collected by Staudinger (Mus. Vien. n° 166)' indicated a single specimen in the Natural History Museum, Vienna, but this specimen could not be found there (pers. com. Herbert Zettel). We defer synonymising the two species until further material from other localities is consulted as the slight differences in the configuration of aedeagal spines could be either specific or variation of a single species. However, both species are found to belong in *Reptalus* based on the five keels on the mesonotum and reduced number of spines on the apex of the first hind tarsomere (see key in HOLZINGER 2003: 70, and Appendix 11), and are thus new combinations in this genus: *Reptalus limbatus* comb. nov. and *R. venosus* comb. nov.

Summary and conclusions

As the earliest descriptions of many European Cixiidae comprise only details of the external appearance, it is not clear how the identities of some species have been established, as species separation is now reliant mainly on the male genitalia. For example, the original description of *Reptalus panzeri* could 'fit' any cixiid with a short vertex and that of *R. quinquecostatus* could 'fit' any Pentastirini species, i.e. species with five mesonotal keels (EMELJANOV 1971). Even in the monumental work of FIEBER (1876), where an astonishing amount of material was borrowed, including many types, and descriptions of the male genitalia of most cixiids are given in detail, the identities of some species were confused and in fact confusion about the idenity of *R. quinquecostatus* and *R. panzeri*, has continued to this day. This includes the identity of one of the two British cixiids with five mesonotal keels, previously known as *R. panzeri* (= *R. quinquecostatus*, of authors) (Figs 11d–f).

With respect to the identities of *R. quinquecostatus* and *R. melanochaetus*, the discoveries outlined in this work require one of two courses of action. Either the type of *Cixius quinquecostatus* is disregarded and a neotype designated, under the Plenary Powers of the Zoological Commission, Article 75.6 (ICZN 1999; see below), or a new name is given for the species previously identified as *R. quinquecostatus* in Continental Europe and *R. panzeri* in Britain. However, with respect to the latter course, as there is no name available a new species would need to be described and also this action would require the synonymy of *R. melanochaetus* with *R. quinquecostatus*.

The purpose of Article 75.6 of the ICZN (1999) is to promote stability where an identity has been widely accepted for many years. This article states: "When an author discovers that the existing name-bearing type of a nominal species-group taxon is not in taxonomic accord with the prevailing usage of names and stability or universality is threatened thereby, he or she should maintain prevailing usage [Art. 82] and request the Commission to set aside under its plenary power [Art. 81] the existing name-bearing type and designate a neotype. Example. On discovering that the only existing type specimen of *Aradus caucasicus* Kolenati, 1857 (Heteroptera) was a specimen of another species, KERZHNER & HEISS (1993) proposed that the prevailing usage of the names of both

species should be conserved by the designation of a neotype for *A. caucasicus* under the Commission's plenary power, and this was accepted in Opinion 1783 (1994)".

In the current case it is the identity of *R. quinquecostatus* and *R. melanochaetus* that would be affected if the type of the former is accepted. However, one could also argue that the problem of misidentification of these species has come about through poor taxonomic work, as no one has previously thought to question the identity of *R. quinquecostatus* and examine the male genitalia of its type, and that such practice should not be condoned. We also feel that disregarding a type should not be undertaken lightly. Therefore has enough time elapsed since the first misidentification and has there been enough published work with the misidentification? Although the ICZN (1999) does not give any advice on this issue we feel sure that on both accounts the currently accepted identities should be upheld. The first misidentification of *R. quinquecostatus*, was by Fieber (1876, in key and unpublished figures), followed by the figures of Dlabola (1952: Figs 11–14), Mityaev (1971: Plate 7, Figs 13, 14, Plate 8, Fig. 1), Logvinenko (1975: Plate 42, Figs 1–3), Holzinger *et al.*, (2003: Fig. 58), Biedermann & Niedringhaus (2004: 120, in pictorial key) and Bertin *et al*. (2010: Fig. 3a). Other numerous references to *R. melanochaetus* and *R. quinquecostatus* in the literature probably also follow this wrong identity.

Based on the above findings we recommend that an application be made to the Zoological Commission to conserve the prevailing usage of the above names, i.e. to disregard the types of *Oliarus quinquecostatus*, and to erect a neotype (Article 75.6, ICZN 1999).

Our discovery that British specimens of *Reptalus panzeri* are misidentified and are in fact *R. quinquecostatus* (of continental authors) requires that this name change is made to the British check-list (Michael Wilson & Alan Stewart, in prep.) while here we also provide an update to the key to British Cixiidae (Appendix 11) given by Le Quesne (1960). Figures of *R. panzeri* are also provided to help separate it from the other British cixiids with five keels on the mesonotum (*P. leporinus*). We also give notes on the distribution and ecology of *R. quinquecostatus* (Appendix 12).

The further discovery made, during the current work, of Fieber's unpublished figures in MNHN that accompanied his (Fieber 1875–79) 'The Cicadines of Europe' sheds light on some other European species that he described. This includes *Reptalus limbatus* (Fieber, 1876) comb. nov., described from Spain. Fieber's figures (Fig. 5d) and those supplied by H. Hoch of a male in Puton's collection (MNHN, Fig. 10) which match a putative type in MNHN (pers. com. Gernot Kunz) show that this species may be the same as *Reptalus venosus* (Rambur, 1840), comb. nov., also from Spain, the type of which (BMNH, London) was figured by Webb (1979: Figs 50–55). Subsequent to the finding of Fieber's manuscript figures those in the family Issidae have also been published (Gnezdilov *et al*. 2011) and others are being studied by Gernot Kunz (in prep.).

Finally, Fieber's (1875) early mention of the word 'Type' (see his source of material examined, Appendix 3b) prompted us to research the history of the 'type concept' and the earliest usage of the word 'Type' (see Appendix 13).

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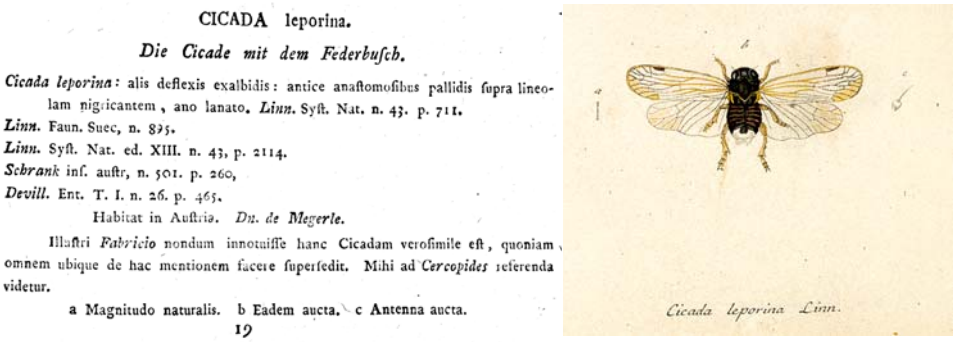
Appendix 1.

The description of *Cicada leporina* Linnaeus, *sensu* Panzer, 1799 (= *Oliarus panzeri* Löw, 1883) (original and translation, from PANZER 1799)

Note. The following description of PANZER (1799) appeared under LINNAEUS's (1761) species name "*leporina*", meaning hare-like and presumably referring to the fluffy wax 'tail'. This feature was mentioned in Linnaeus's description as "woolly anus" and in Panzer's description as "Federbusch" (a term normally referring to a head plume). These terms together with Panzer's figure of the female indicate that the description was based on the female. The passage consists of Linnaeus's original summary to his species description, its original and subsequent references (not cited here), habitat and collector information, and finally a brief comment by Panzer and legend to his figure. The species was subsequently renamed as a new species by LÖW (1883) (see Appendix 6).



CICADA leporina.

Die Cicade mit dem Federbuſch.

Cicada leporina: alis deflexis exalbidis: antice anaſtomoſibus pallidis ſupra lineolam nigricantem, ano lanato. *Linn.* Syſt. Nat. n. 43. p. 711.
Linn. Faun. Suec, n. 895.
Linn. Syſt. Nat. ed. XIII. n. 43, p. 2114.
Schrank inſ. auſtr, n. 501. p. 260,
Devill. Ent. T. I. n. 26. p. 465.
Habitat in Auſtria. *Dn. de Megerle.*

Illuſtri *Fabricio* nondum innotuiſſe hanc Cicadam verosimile eſt, quoniam omnem ubique de hac mentionem facere ſupersedit. Mihi ad *Cercopides* referenda videtur.

a Magnitudo naturalis. b Eadem aucta. c Antenna aucta.

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Cicada leporina Linn.

Fig. 1. The original description and figure of *Oliarus panzeri*, from PANZER (1799: 19).

Translation from PANZER (1799) [added text is in square brackets]

CICADA leporina.

Die Cicade mit dem Federbusch.

Cicada leporina: wings bent downwards transparent: in front anastomoses pale above line blackish, anus woolly. ...

Habitat in Austria. Dn. de Megerle.

In the illustrated Fabricius [1799] this Cicada is not yet made known and everybody everywhere refrains from mentioning it. In my opinion it should be counted among the *Cercopids*.

[Figure legends:] a Actual size. b Enlarged. c Antenna enlarged.

Appendix 2.

The description of *Flata pallida* Herrich-Schäffer, 1835 (original and translation and his 1838 figure of un-named variety of *pallida*)

55. F l a t a.

I. Nervus costalis impunctatus.
1. Tibiæ posticæ muticæ musiva.
2. - - armatæ.
A. Elytra albo-hyalina, nervis subfuscis, nigropunctatis, stigmate nigro-fusco, basi late albo, cellulam radialem primam intrante; cellulæ apicales 4. 6. 9. petiolatae leporinus.
B. Elytra flavescenti-hyalina, nervis flavis, apicem versus fusco-alternantibus, stigmate albo intus linea fusca terminato; cell. rad. 2-4. 6. 9. petiolatae pallidus.

II. Nervus costalis punctatus.



Fig. 2. The original description of *Flata pallida* (from Herrich-Schäffer 1835: 64); the original figure of *Flata pallida* un-named variety (from Herrich-Schäffer 1838: plate no. 154.4).

Translation of the original description of *Flata pallida* from Herrich-Schäffer (1835: 64)

55 Flata.

I. Costal veins not spotted
1. Posterior tibiae smooth. *musiva*
2. - - with spines
A. Elytra whitish-hyaline, veins dusky, black-spotted, stigma black-dusky, broadly white at base, first radial cell entering[?!]; apical cells 4, 6 and 9 petiolate. *leporinus*
B. Elytra yellowish-hyaline, veins yellow, dusky-banded toward the apex, stigma white delimited internally by a dusky line; radial cells 2–4, 6 and 9 petiolate. *pallidus*

II. Costal veins spotted [leads to *simplex*, *albicincta*, *contaminata*, *stigmatica* and *nervosa*]

Note. Herrich-Schäffer (or the printer) seems to have made a mistake with the last line, omitting the contrast to the radial cell and not stating that it is the apical cells 2–4, 6 and 9 that are petiolate.

Appendix 3a.

Preface of the translator of FIEBER'S (1875) 'The Cicadines of Europe' Part 1 (original and translation)

Note. Fieber's 'The Cicadines of Europe' was published posthumously in several parts in French from the original unpublished German manuscript, the later work now located in MNHN. Here we give the Preface by its translator (Reiber) followed by our translation of the same. This first part of Fieber's study deals with morphology and gives a key to genera. Species descriptions, in the form of a key, formed the basis of the remaining parts of which the Cixiidae were dealt with in the second part (FIEBER 1876). Fieber's reference to his unpublished figures (found in MNHN as a result of our study), are noted in the third paragraph (see also Appendix 3b).

288 REVUE ET MAGASIN DE ZOOLOGIE, 1875.

LES CICADINES D'EUROPE

D'APRÈS LES ORIGINAUX ET LES PUBLICATIONS LES PLUS RÉCENTES

PREMIÈRE PARTIE :

Comprenant les familles des Membracida, Cicadaea, Fulgorida, Cercopida, Ulopida, Paropida, Scarida, disposées selon la méthode analytique,

Par le Dr Franz-Xavier FIEBER.

Traduit de l'allemand

Par Ferd. REIBER,

Membre de la Société entomologique de France.

PRÉFACE DU TRADUCTEUR

En 1872, le Dr Fieber publiait le catalogue des Cicadines d'Europe [1]. Ce catalogue était le précurseur d'un grand ouvrage descriptif que le savant autrichien se proposait de livrer sous peu à la publicité.

La maladie retarda d'abord la publication du livre annoncé, et, enfin, le 23 février 1872, la mort de l'auteur vint en ajourner indéfiniment l'apparition. L'éditeur rendit le manuscrit à madame veuve Fieber, et il ne se trouva pas de naturaliste allemand qui voulût honorer la mémoire du grand hémiptériste en soignant l'impression de son ouvrage. Seul, mon ami le Dr Puton fit constamment les plus grands efforts pour sauver de l'oubli ce grand travail de bénédictin. Ses efforts restèrent malheureusement infructueux.

1. Katalog d. europaeischen Cicadinen. Wien, Gerold's Sohn, 1872.

TRAVAUX INÉDITS. 289

Au commencement de cette année, je me décidai à mon tour à reprendre les démarches du Dr Puton. Plus heureux que lui, j'eus la satisfaction de sauver le manuscrit. Je l'achetai à la veuve de l'auteur à frais communs avec MM. Puton, de Remiremont, et Lethierry, de Lille, depuis longtemps possesseurs des dessins de Fieber. Malheureusement quelques parties du manuscrit étaient déjà perdues. Placés dans l'alternative de publier un travail fragmentaire ou de compléter ce travail, mes amis n'hésitèrent pas. Ils me proposèrent de le compléter, c'est-à-dire d'entreprendre, eux la monographie des genres perdus, et ils me prièrent de traduire en français la partie sauvée du manuscrit, afin de pouvoir livrer à la publicité un ouvrage homogène et de même langue. J'hésitai d'abord à entreprendre ce travail difficile et de longue haleine; mais mes amis m'ayant offert leur concours dévoué, mes scrupules se levèrent et je me mis à l'ouvrage.

Telle est, en résumé, l'histoire du travail dont nous publions aujourd'hui le commencement.

Nous reproduirons fidèlement le manuscrit de l'auteur, sans innovation aucune et sans y ajouter les nouvelles espèces décrites depuis l'apparition du catalogue qui résume tout l'ouvrage. Seuls les genres perdus et traités à nouveau par MM. Puton et Lethierry feront exception à la règle et seront des monographies spéciales de leurs auteurs.

Notre but est de sauver de l'oubli le fruit des longues années d'études de notre maître vénéré et de livrer au public entomologique un travail général sur un ordre d'insectes encore très-peu étudié par suite du manque d'ouvrages généraux. Puissions-nous mener à bonne fin notre entreprise !

Quant à moi, je suis heureux de doter la science française de la traduction d'un ouvrage magistral inédit. J'ose espérer que les entomologistes français me pardonneront

(Revue et Mag. de Zoologie. 1875.) 19

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les imperfections de cette traduction en me tenant compte des difficultés que présente une pareile entreprise.

Ferd. REIBER.

Strasbourg, juin 1875.

Fig. 3. Preface of the translator of FIEBER's (1875) 'The Cicadines of Europe' Part 1, pages 288–290.

Translation of the Preface of the translator of Fieber's (1875) 'The Cicadines of Europe' Part 1, pages 288–290

THE CICADINES OF EUROPE

FROM THE ORIGINALS AND THE MOST RECENT PUBLICATIONS

FIRST PART:

Comprising the families of the Membracida, Cicadaea,
Fulgorida, Cercopida, Ulopida, Paropida,
Scarida. arranged according to the analytic method.

By Dr Franz-Xavier FIEBER

Translated from German

By Ferd. REIBER,
Member of the entomological Society of France

PREFACE OF THE TRANSLATOR

In 1872, Dr Fieber published the catalogue of the Cicadines of Europe[1]. This catalogue was the precursor of a big descriptive work that the Austrian scientist intended to publish soon after.

Illness first delayed the publication of the announced book, and, finally, on February 23, 1872, the author's death came to postpone its appearance indefinitely. The editor returned the manuscript to Mrs Fieber, and there was not one German naturalist to be found who wanted to honour the memory of the great hemipterist by taking care of the impression of his work. My friend Dr Puton, alone, constantly made the biggest efforts to save from oblivion this masterpiece of patience. His efforts unfortunately remained fruitless.

At the beginning of this year, I decided in my turn to start again the steps where Dr Puton had left them. Luckier than he, I had the satisfaction to save the manuscript. I bought it from the author's widow sharing the expenses with Messrs Puton, de Remiremont, and Lethierry, of Lille, since a long while in possession of Fieber's drawings. Unfortunately, some parts of the manuscript were already lost. Placed with the alternative to publish a piecemeal work or to complete it, my friends didn't hesitate. They offered me to complete it, which meant for them to undertake the monograph of the lost genera while they asked me to translate into French the saved part of the manuscript, in order to be able to publish a homogeneous work in the same language. I first hesitated to undertake this difficult and long-winded task but my friends having offered to me their devoted support, my scruples departed and I set to work.

Such is, to sum it up, the history of the work of which we publish the beginning today.

We will reproduce the author's manuscript faithfully, without any innovation and without adding the new described species since the appearance of the catalogue that summarizes the whole work. Only the lost genera, treated again by Messrs Puton and Lethierry, will be an exception to the rule and will be special monographs of their authors.

Our goal is to save from oblivion the fruit of our venerated master's long years of study and to deliver to the entomological public a general work on an order of insects still very little studied due to the lack of general works. May we bring this enterprise to a successful completion!

As for me, I am pleased to endow French science with the translation of an unpublished masterly work. I dare hope that French entomologists will forgive me the imperfections of this translation while taking into account the difficulties that present such an enterprise.

Ferd. REIBER.

Strasbourg, June 1875.

[1] Katalog d. europaeischen Cicadinen. Gerold's Sohn, 1872.

Appendix 3b.

Preface by Fieber to his 'The Cicadines of Europe' Part 1, 1875 (translation from Fieber 1875: 290–294)

Note. Fieber states below that he was able to borrow specimens (including 'types') from all those that he requested material from (except Kirschbaum). He also notes that he figured in colour all the type specimens (see fourth paragraph from end of Preface). Although these figures were not reproduced it would appear from the translator's comments above '(Appendix 3a) and translators footnote (see end of this Appendix) that they were in the possession of Lethierry, before being given to the Paris Museum (see Appendix 5).

PREFACE OF THE AUTHOR

Different friends having asked me to get back to my works on the Cicadines, works interrupted for many years due to the lack of books and sufficient material, such as original specimens, I decided, in the year 1864, to put myself back to the task and to undertake a work on the Cicadines of Europe. I didn't hide the importance of this enterprise to myself, but I had however no idea of the pain that such a work required or of the difficulties it presented. Indeed, it is only in the course of these new studies that I recognized how difficult it is to gather the necessary materials, often scattered in works and collections not so easily available, to examine and to describe all species and the originals according to a method appropriate to the present level of science, and to guide oneself, in the absence of all other general work, apart from the Rhynchoten Lievlands, by Dr G. Flor, 1861.

[The next section of Fieber's preface deals with the source of his borrowed material. These we have rearranged alphabetically and paraphrased].

Mr Berquier, indeterminate Cicadines, collected around Trieste [Italy].

Mr Bohemann loaned, when in Prague, a lot of Swedish Cicadines and his *Nova Svenska Homopts.*

Mr Brischke, undetermined Hemiptera and Cicadines, gathered around Danzig [Poland] and exceptionally prepared.

Mr Erber, several times, consignments from Corfu, Syra, Tixos, Montenegro, in which were many rarities or novelties

Dr Flor sent his new species as well as a lot of others, and his work on the Rhynchotes of Livonia.

Knight von Frauenfeld, a lot of small indeterminate Cicadines, for the most part Jassids, and of Austrian source.

Mr. Frey-Gessner placed at my disposal his rich collection of species from Switzerland, the south of Russia, Corsica, France and Spain (collected by Meyer-Dür).

Mr Fritsch, vice-director, Cicadines from Bohemia and Salzburg

Pater Vincent Gredler, Tyrolean species [Austria].

Dr Heller, unnamed species, collected around Innsbrück and in the Stubaithal [Austria].

Mr Lucas von Heyden, for the communication of all Cicadines that served to the work of Kirschbaum, entitled the " *Cicadinen von Wiesbaden*, " communication which allows me to review and to rectify this author's work.

Messrs Lethierry and *Dr Puton*, bugs from the department of the North and from Algeria

Dr Mayr, a great deal of Herrich-Schaeffer's types, of Austrian and Hungarian species, of others collected around Naples by Mr Emery, and, finally, Cicadines described by Kirschbaum.

Mr Mink communicated me his Cicadines collected around Crefeld [Germany].

Messrs Mulsant and *Rey* loaned a great deal of Cicadines from the South of France, among which were several of the species described by them, as well as some new species.

Dr Nowicky, Hemiptera and Cicadines of the Carpatheans and different regions of the Galicia.

Mr Oschannin, Russian species from some provinces.

Dr Redtenbacher, director of the Imperial Cabinet of Natural History in Vienna, and of *Mr Rogenhofer*, its curator, the communication of the typical species of Fabricius, Megerle, Mann and Kolenaty which can be found at this museum.

Mr Scott (p. 292) species from different parts of England.

Dr Stål was promising to come to my help by procuring for me the types of the Swedish authors, a promise kept by the consignment of these types and of a lot of species from other countries.

Dr Stein sent me a great deal of small species collected in Greece by Dr Krüper, species of which some were named; he added to it a certain number of Germar's types, on the validity of which I had some doubts as species.

Messrs Ungerer and *Professor Kissl*, Hemiptera and Cicadines from Bavaria.

Mr *Wüstnei,* the candidate in philosophy, species from Mecklenburg [Germany].

I extend here to all aforementioned correspondents my best thanks for the confidence they have shown me in sending their Cicadines and in thus allowing me to write and complete the present work. The unfortunate postponement of the appearance of this book comes in part from my serious and long illness of the years 1868 and 1869–1870.

While examining the rich materials at my disposition, I recognized that the venation of the elytra and wings was of prime importance in order to separate and create genera, but that the characters taken from the shape of the head, the antennae, from the pro- and mesonotum, the legs and their different armature, also had to be taken into consideration, naturally. As for distinguishing the species, I had to use not only on the characters taken from the structure of the different parts of the body, the outline, the coloration and the armature, but especially the examination of the genitalia of the two sexes. Dr Flor had already recognized partially, in his excellent work on the Rhynchotes of Livonia, that the examination of the genitalia was absolutely necessary for the distinction of the species. Kirschbaum, in this matter, has only imitated him.

I found, in addition to the organs mentioned by Dr Flor, / / p. 293 / / two other organs used neither by him, nor by Kirschbaum: 1. the bent, non articulate styles, *styli*, *griffel*

[mentioned by mistake in the Grundzüges zur gener. Theilung d. Delphacini, in the Verhanld.k.k.zool. bot. Ges., 1866, under the name of *Raife* (hoops, in the Orthoptera, *Cerci*, articulate anal appendices, griffel)], that one may find among the males, in the open (in the delphacids, cixiids, etc.) or hidden (in the scarids and the jassids). Flor reports these appendices in the *Cixius*, but is not concerned further about them. Kirschbaum only describes them for some genera of Fulgorids, and often in an inexact way; he does not bother about them with the Cercopids, Jassids. 2. Among the females of the Delphacines, the *lateral plates* (nebenplatten), *paraplagae*. [*ibid*, p. 517; basilary or lateral plates (grundplatten or nebenplatten). J. R. Sahlberg in his Ofvers. Finlands Cicadaria, 1871, t. I, fig. 6, calls them *lateral lobi*.] These two organs provide, in their different variations, good characters for the exact determination of the species.

After grouping and inspection of the materials at my disposition, I found that the number of the species had nearly doubled, more than doubled even in a lot of genera. Once it was begun, I didn't spare any pains or money to bring the work to a satisfactory conclusion. As – according to Dr Stal – the types of Fallen no longer exists today other than by tradition, as many other species are very difficult to see or to obtain, since unique examples are scattered in various collections and a lot of types are lost due to accident or decay, I reproduced by coloured drawings each of the original types that I had been given to examine. These drawings[1], / / p. 294 / / 10 of which appear on every 8°, should serve to distinguish in times to come the species in an indubitable way and to form the basis on which rests the present book.

The genera and their characters are featured in a separate notebook, and to the number of 6 on every 8°. The present work will therefore consist of 3 volumes with the drawings.

I have a thorough knowledge of the literature dealing with my topic. I am in part indebted for it to Messrs Stål, Mayr, Signoret, Scott, J., Sahlberg and Rogenhofer, for sending excerpts of works in various languages, difficult to obtain, and in loans of the Viennese libraries of the Imperial Cabinet of Zoology, the Court and Society zoolog. Botany. I owe to M. Dohrn the Fulgorids of Dr Schaum (in Encycl. Der Wissensch).

Mr. Kirschbaum whom I have, since 1866, asked five times by letter to communicate to me the new species that he personally possesses and which I didn't see in other collections, has kept an obstinate silence, although I have offered him twice the guarantee for the safe return of his consignment. There remains therefore only a small number of his novelties which I haven't seen and of that the value as species is doubtful, given that no one knows them. Mr. Kirschbaum probably fears changes to his determinations and finds it more important to publish many new species, without sufficient knowledge of those described hitherto, quickly and without complete knowledge of the bibliography dealing with the topic. This naturalist prefers to leave others to solve his enigmas.

The limits of the fauna of the Cicadines of Europe, and the *zones* where they abound are the same than those of my Hemiptera of Europe.

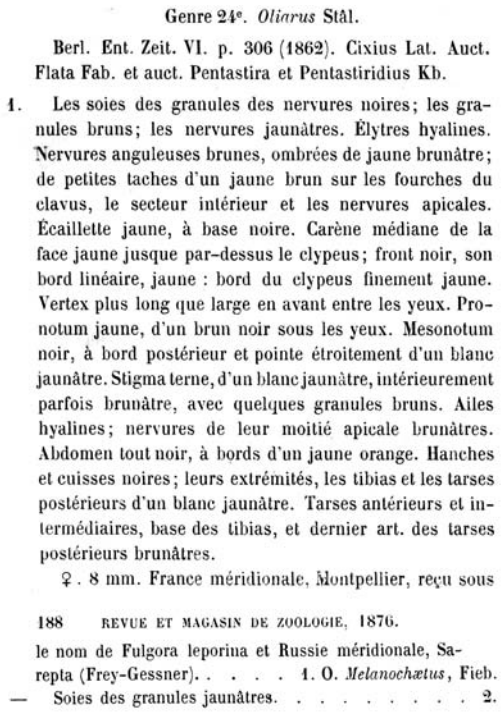
Dr F.-X. FIEBER

[1] These coloured drawings --the finish and accuracy of which is admirable-- are now owned by Messrs. Lethierry and Puton who would be happy to make them available to the publisher or the Society willing to publish them.

Appendix 4.

The description of *Oliarus melanochaetus* Fieber, 1876 (original and translation)

Note. Fieber's description of *O. melanochaetus* appeared in the first half of the first couplet to a key of *Oliarus* species.



Genre 24e. *Oliarus* Stål.

Berl. Ent. Zeit. VI. p. 306 (1862). Cixius Lat. Auct. Flata Fab. et auct. Pentastira et Pentastiridius Kb.

1. Les soies des granules des nervures noires; les granules bruns; les nervures jaunâtres. Élytres hyalines. Nervures anguleuses brunes, ombrées de jaune brunâtre; de petites taches d'un jaune brun sur les fourches du clavus, le secteur intérieur et les nervures apicales. Écaillette jaune, à base noire. Carène médiane de la face jaune jusque par-dessus le clypeus; front noir, son bord linéaire, jaune : bord du clypeus finement jaune. Vertex plus long que large en avant entre les yeux. Pronotum jaune, d'un brun noir sous les yeux. Mesonotum noir, à bord postérieur et pointe étroitement d'un blanc jaunâtre. Stigma terne, d'un blanc jaunâtre, intérieurement parfois brunâtre, avec quelques granules bruns. Ailes hyalines; nervures de leur moitié apicale brunâtres. Abdomen tout noir, à bords d'un jaune orange. Hanches et cuisses noires; leurs extrémités, les tibias et les tarses postérieurs d'un blanc jaunâtre. Tarses antérieurs et intermédiaires, base des tibias, et dernier art. des tarses postérieurs brunâtres.

♀. 8 mm. France méridionale, Montpellier, reçu sous

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le nom de Fulgora leporina et Russie méridionale, Sarepta (Frey-Gessner). . . . . 1. O. *Melanochætus*, Fieb.

— Soies des granules jaunâtres. . . . . 2.

Fig. 4. The original description (in key) of *Oliarus melanochaetus* (from Fieber 1876: 187–188).

Translation of the original description of *Oliarus melanochaetus* from Fieber (1876: 187–188). The alternative halves of the couplet are emphasized in bold.

1. **Bristles of the granules of the nerves black**; granules brown, nerves yellowish. Elytra hyaline. Angular nerves brown with yellow brownish shades; small spots of a yellowish-brown on the forks of the clavus, the interior sector and the apical nerves. Tegula yellow, with a black base. Median carina of the face yellow until above the clypeus; frons black with its linear edge yellow; edge of the clypeus finely yellow. Vertex longer than broad at the front between the eyes. Pronotum yellow, of a black brown under the eyes. Mesonotum black, with the posterior edge and the tip of a yellowish white. Stigma dull, yellowish white, sometimes internally brownish, with some brown granules. Wings hyaline; nerves of their apical half brownish. Abdomen completely black with yellow orange edges. Coxae and femurs black; their extremities, tibiae and posterior tarsi of a yellowish white. Anterior and intermediary tarsi, base of the tibiae and last segment of the posterior tarsi brownish. ♀ 8 mm. South of France, Montpellier, known as *Fulgora leporina* and southern Russia, Sarepta (Frey-Gessner). .... **1. *O. melanochaetus* Fieb.**

– **Bristles of the granules yellowish.** 2

Appendix 5.

The unpublished figures that accompanied Fieber's (1875–1879) 'The Cicadines of Europe'

Notes. The unpublished figures of FIEBER's 'The Cicadines of Europe' (1875–1879) were found in the Paris Museum Library as a result of the current work. Figures from those plates, showing *Oliarus quinquecostatus*, *O. melanochaetus* and *O. limbatus*, are reproduced here (Fig. 5). The genitalia figures of Fieber's Fig. 16 are labelled "*artemisae*" but crossed through and *quinquecostatus* written in pencil. According to METCALF's (1936) catalogue *Oliarus artemisae* Becker is a nomen nudum and synonym of *O. quinquecostatus*. The only place "*artemisae*" appears in Fieber's key is under *O. quinquecostatus*, saying the two species are confused.

The following discrepancies are found with respect to the figure numbers given in FIEBER's (1876) Cixiidae key and the unpublished figures: *O. quinquecostatus* is numbered Fig. 16 in Fieber's key but is numbered both 16 and 17 on the plate (bottom left on each figure shown here); *O. cuspidatus* (not shown) is numbered Fig. 17 in Fieber's key but is numbered 18 on the figure; *O. apiculatus* (not shown) is numbered Fig. 18 in Fieber's key but is numbered 19 on the figure.

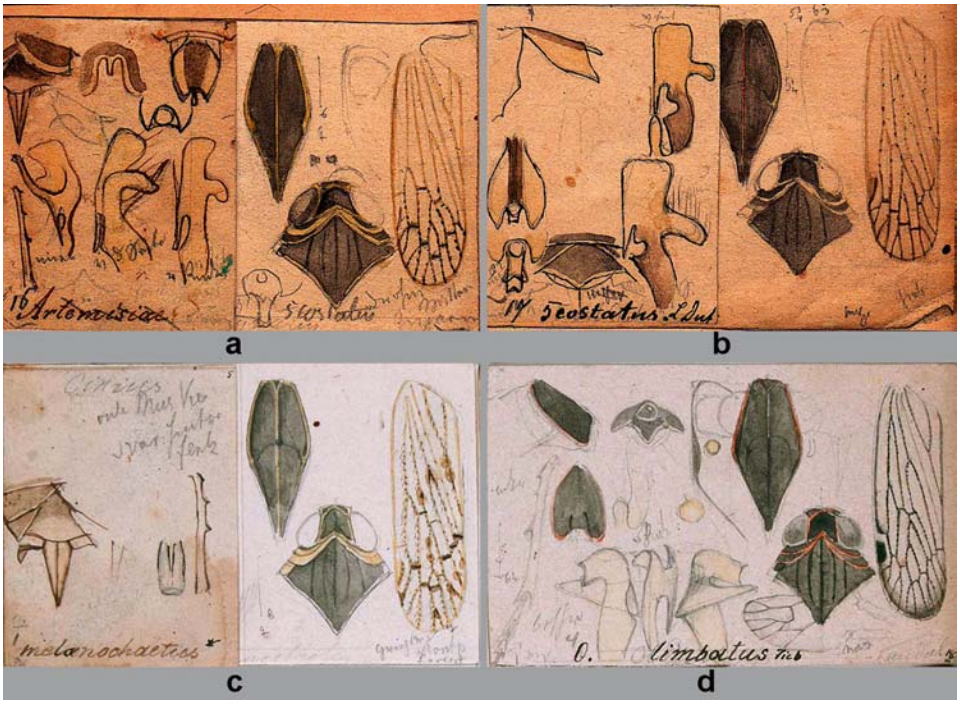
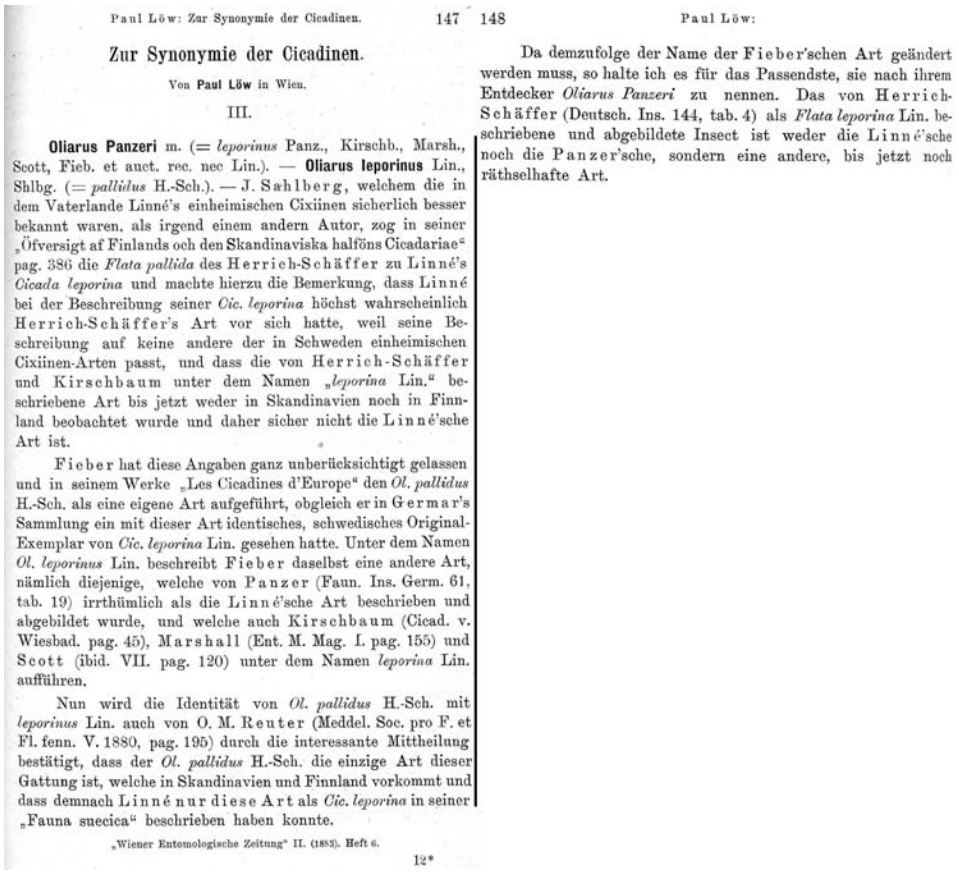


Fig. 5. Unpublished figures from FIEBER's (1876) 'The Cicadines of Europe'. a–b – *Oliarus quinquecostatus*; c – *O. melanochaetus*; d – *O. limbatus*.

Appendix 6.
Comments on synonymy in *Oliarus* by Löw (1883: 147–148) (original and translation).



Paul Löw: Zur Synonymie der Cicadinen. 147

Zur Synonymie der Cicadinen.

Von **Paul Löw** in Wien.

III.

Oliarus Panzeri m. (= *leporinus* Panz., Kirschb., Marsh., Scott, Fieb. et auct. rec. nec Lin.). — **Oliarus leporinus** Lin., Shlbg. (= *pallidus* H.-Sch.). — J. Sahlberg, welchem die in dem Vaterlande Linné's einheimischen Cixiinen sicherlich besser bekannt waren, als irgend einem andern Autor, zog in seiner „Öfversigt af Finlands och den Skandinaviska halföns Cicadariae" pag. 386 die *Flata pallida* des Herrich-Schäffer zu Linné's *Cicada leporina* und machte hierzu die Bemerkung, dass Linné bei der Beschreibung seiner *Cic. leporina* höchst wahrscheinlich Herrich-Schäffer's Art vor sich hatte, weil seine Beschreibung auf keine andere der in Schweden einheimischen Cixiinen-Arten passt, und dass die von Herrich-Schäffer und Kirschbaum unter dem Namen „*leporina* Lin." beschriebene Art bis jetzt weder in Skandinavien noch in Finnland beobachtet wurde und daher sicher nicht die Linné'sche Art ist.

Fieber hat diese Angaben ganz unberücksichtigt gelassen und in seinem Werke „Les Cicadines d'Europe" den *Ol. pallidus* H.-Sch. als eine eigene Art aufgeführt, obgleich er in Germar's Sammlung ein mit dieser Art identisches, schwedisches Original-Exemplar von *Cic. leporina* Lin. gesehen hatte. Unter dem Namen *Ol. leporinus* Lin. beschreibt Fieber daselbst eine andere Art, nämlich diejenige, welche von Panzer (Faun. Ins. Germ. 61, tab. 19) irrthümlich als die Linné'sche Art beschrieben und abgebildet wurde, und welche auch Kirschbaum (Cicad. v. Wiesbad. pag. 45), Marshall (Ent. M. Mag. I. pag. 155) und Scott (ibid. VII. pag. 120) unter dem Namen *leporina* Lin. aufführen.

Nun wird die Identität von *Ol. pallidus* H.-Sch. mit *leporinus* Lin. auch von O. M. Reuter (Meddel. Soc. pro F. et Fl. fenn. V. 1880, pag. 195) durch die interessante Mittheilung bestätigt, dass der *Ol. pallidus* H.-Sch. die einzige Art dieser Gattung ist, welche in Skandinavien und Finnland vorkommt und dass demnach Linné nur diese Art als *Cic. leporina* in seiner „Fauna suecica" beschrieben haben konnte.

Da demzufolge der Name der Fieber'schen Art geändert werden muss, so halte ich es für das Passendste, sie nach ihrem Entdecker *Oliarus Panzeri* zu nennen. Das von Herrich-Schäffer (Deutsch. Ins. 144, tab. 4) als *Flata leporina* Lin. beschriebene und abgebildete Insect ist weder die Linné'sche noch die Panzer'sche, sondern eine andere, bis jetzt noch räthselhafte Art.

Fig. 6. Comments on synonymy in *Oliarus* by Löw (1883).

Translation of the comments on synonymy in *Oliarus* by Löw (1883: 147–148)

Note: Added text is in square brackets.

About the synonymy of the Cicadaria
By Paul Löw in Vienna

Oliarus Panzeri m. (= *leporinus* Panz., Kirschb., Marsh., Scott, Fieb. *et auct. ree. nec.* Lin.)

Oliarus leporinus Lin., Sahlbg. (= *pallidus* H.-Sch.)

J. Sahlberg, who certainly knows the cicades local to the home country of Linné [Sweden] better than any other author, in his "Öfversigt af Finlands och den Skandinaviska halföns Cicadariae" [1871] page 386 put the *Flata pallida* of Herrich-Schäffer [1835, locality not known] with Linné's [1761] *Cicada leporina* and made the comment, that Linné was likely to have had Herrich-Schäffer's species in front of him when he was describing his *Cic. leporina*, because his description does not fit any other species of the cixiids local to Sweden and that the species described by Herrich-Schäffer [1837] and Kirschbaum [1868] with the name of "*leporina Lin."* has not been observed either in Scandinavia or in Finland and therefore surely is not Linné's species.

Fieber [1876] did not consider these comments at all in his work "Les Cicadines d'Europe" listing the *01. pallidus H.-Sch.* as a valid species, although he saw an identical, Swedish specimen of *Cic. leporina Lin.* in the collection of Germar. Fieber describes under the name of *01. leporinus Lin.* a different species, namely the one that Panzer (Faun. Ins. Germ. 61, tab. 19) erroneously described and illustrated as Linné's species, and which furthermore Kirschbaum [1868] (Cicad. v. Wiesbad, pag 45), Marshall [1864] (Ent. M. Mag. I. pag 155) and Scott [1870] (ibid. VII. pag 120) list by the name of *leporina Lin.*

The equivalence of *01. pallidus H.-Sch.* and *leporinus Lin.* is also confirmed by M. Reuter (Meddel. Soc. pro F. et Fl. fenn. V. 1880, pag 195) through the interesting message, that *01. pallidus H.-Sch.* is the only species in this genus which occurs in Scandinavia and Finland thus Linné could only have described this species as *Cic. leporina* in his "Fauna suecica".

As therefore the name of Fieber's [*leporina*] species needs to be changed, I think it would be suitable to name it after its discoverer *Oliarus panzeri.* The insect described and illustrated as *Flata leporina Lin*. by Herrich-Schäffer [1837] (Deutsch. Ins. 144, tab. 4) is neither Linné's nor Panzer's species but another, until now mysterious species".

Appendix 7.

The description of *Flata pallens* Germar, 1821 (original and translation)

2) *Flata* pallens m. capite obtuſo, albida, capite pectoreque nigris. Habitat in Tauria. *Steven.*

Etwas gröſser als *F.* nervoſa, vom Kopfe bis zur Deckſchildſpitze 4 par. Linien lang. Der Kopf vorn ſtumpf gerundet, übrigens ganz wie bei F. nervoſa gebaut, ſchwarz, alle aufgeworfenen Ränder und Kiele gelb. Der Halskragen ſehr kurz, oben in der Mitte ſcharfwinklich ausgeſchnitten, gelb, in den Vertiefungen ſchwarz. Das Rückenſchild gelb, rhomboidal, in der Mitte oben platt, mit fünf Längskielen. Die Flügelſchuppe an der Wurzel der Deckſchilde, welche alle Fulgorellen beſitzen, gelbweiſs. Die Deckſchilde noch einmal ſo lang als der Hinterleib, trüb-gelblichweiſs, die Adern gelber, die kleinen treppenförmigen Queeradern, ſo wie die Spitzen aller Längsadern rauchgrau. Die Flügel ungefärbt, die Adern von der letzten Spaltung weg, ſchwarz. Die Un-

Unterſeite ſchwarz, die Ränder der Ringe des Hinterleibes gelb. Die Beine gelb, auf den Schenkeln ein ſchwarzer Längsſtrich.





Fig. 7a. The original description of *Flata pallens* (from GERMAR 1821: 101–102). (Left.)

Fig. 7b. Type of *Flata pallens* Germar (ZML, Lviv). (Above.)

Translation of the original description of *Flata pallens* (from GERMAR 1821)

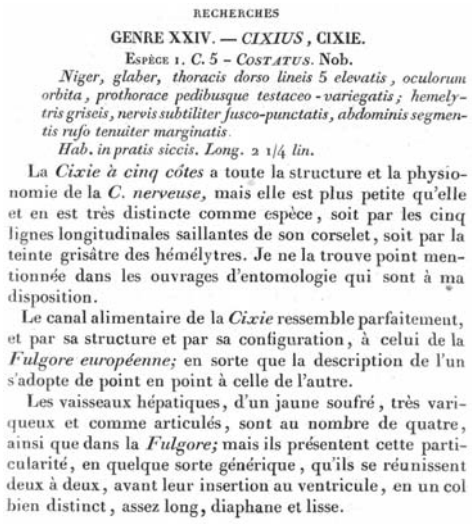
2) *Flata pallens* mine. Head obtuse; whitish; head and chest, black. Habitat in Tauria. Steven.

Slightly larger than *F. nervosa*, from the head to the tips of the elytra 4 par. lines long. The head at the front obtusely rounded – incidentally, entirely as in *F. nervosa* – black, all raised margins and keel yellow. The pronotum very short, cut in a sharp angled manner at the top in the middle, yellow, black in the recesses. The mesonotum yellow, rhomboidal, flat at the top in the middle, with five longitudinal keels. The tegulae at the base of the elytra, which all Fulgorids have, yellow white. The elytra again twice as long as the abdomen, dull yellowish white, yellow veins, small step-like tranverse veins, as the tips of all longitudinal veins, smoky grey. The wings unstained, the veins away from the last cleavage, black. The [p. 102] underside black, the edges of the rings of the abdomen yellow. The legs yellow, on the femur, a black long line.

Appendix 8.

The description of *Cixius quinquecostatus* Dufour, 1833 (original and translation)

Note. Léon Jean Marie (or Jean-Marie Léon) Dufour (1780–1865) was a French medical doctor and naturalist whose collection of insects is preserved in MNHN. The following original description of *R. quinquecostatus*, appeared in an article on the anatomy and physiology of insects (DUFOUR 1833) and it is presumably for this reason that Dufour describes the digestive tract in some detail. A further description of the latter appeared some years later (DUFOUR 1839).



RECHERCHES

GENRE XXIV. — *CIXIUS*, CIXIE.

ESPÈCE 1. *C. 5 - COSTATUS.* Nob.

Niger, glaber, thoracis dorso lineis 5 elevatis, oculorum orbita, prothorace pedibusque testaceo-variegatis; hemelytris griseis, nervis subtiliter fusco-punctatis, abdominis segmentis rufo tenuiter marginatis.

Hab. in pratis siccis. Long. 2 1/4 *lin.*

La *Cixie à cinq côtes* a toute la structure et la physionomie de la *C. nerveuse,* mais elle est plus petite qu'elle et en est très distincte comme espèce, soit par les cinq lignes longitudinales saillantes de son corselet, soit par la teinte grisâtre des hémélytres. Je ne la trouve point mentionnée dans les ouvrages d'entomologie qui sont à ma disposition.

Le canal alimentaire de la *Cixie* ressemble parfaitement, et par sa structure et par sa configuration, à celui de la *Fulgore européenne;* en sorte que la description de l'un s'adopte de point en point à celle de l'autre.

Les vaisseaux hépatiques, d'un jaune soufré, très variqueux et comme articulés, sont au nombre de quatre, ainsi que dans la *Fulgore;* mais ils présentent cette particularité, en quelque sorte générique, qu'ils se réunissent deux à deux, avant leur insertion au ventricule, en un col bien distinct, assez long, diaphane et lisse.

Fig. 8. The original description of *Cixius quinquecostatus* (from DUFOUR 1833: 224).

Translation of the original description of *Cixius quinquecostatus* from DUFOUR (1833)

GENUS XXIV. – *CIXIUS*, *CIXIE*.

SPECIES I. C.*5*-*COSTATUS*. New.

Black, glabrous, back of thorax with 5 elevated lines, orbits of the eyes, prothoracic legs mottled with deep reddish brown; hemelytra grey, nerves finely brown spotted, abdominal segments with light reddish margins.

Habitat in dry meadows. Length: 2 1/4 lines [= 0.5 cm approx.].

The *Cixie* with five ribs has all the structure and aspect of *C. nerveuse*, but is smaller than the latter and is very distinct from it as a species, either by the five projecting longitudinal lines on the rear of the thorax, or by the greyish colour of its hemelytra. I do not find it mentioned in the works of Entomology that are at my disposal.

The digestive tract of the *Cixius* perfectly resembles, in structure and in configuration, that of the European *Fulgora*; so that the description of the one matches point by point that of the other.

The hepatic vessels, of a sulphur yellow, very varicose and as articulated, number four, like in *Fulgore* but they present this characteristic, to some extent generic, that they meet two by two, before their insertion into the ventricle, in quite a distinct collar, rather long, diaphanous and smooth.

Appendix 9.

Notes on the type series of *Cixius quinquecostatus* Dufour (= *melanochaetus* of authors)

Type material examined. Syntypes: 1 ♂, Spain?; 1 ♀, no data; 1 specimen without abdomen and data (coll. Dufour, MNHN).

Remarks. In the original description of this species DUFOUR (1833) gave no details of the specimens he examined (see Appendix 8). However, the unlabelled specimen without abdomen could be the same that was dissected in order to give the description of the digestive system and later a more detailed description of the same (DUFOUR 1839). Later, Dufour says that he collected a male and female in copula in August 1829, which might be the same male and female in the collection (Figs 9a–d). Only this male has a data label, that could say (in an indistinct hand) the single word 'Llayo' (Cillorigo de Liébana), in the north of Spain, on the opposite side of the Pyrenees from Saint Sever, where Dufour lived. As these specimens do not disagree with the original description of *C. quinquecostatus* they are regarded as putative types.

The following additional information (paraphrased) on Dufour's collection has been supplied by Adeline Soulier-Perkins (MNHN): when Dufour died, Joseph Alexandre Laboulbène recurated the collection for the museum, but it was not in good condition. Perris reconditioned the specimens in new boxes with all the original labels at the bottom of the boxes. Some of the Dufour types stayed in the Edouard Perris collection that is in Montpellier. I have checked a copy of the catalogue of Perris's collection but there is no mention of the *Cixius quinquecostatus* type, so the types should be the specimens in Paris.

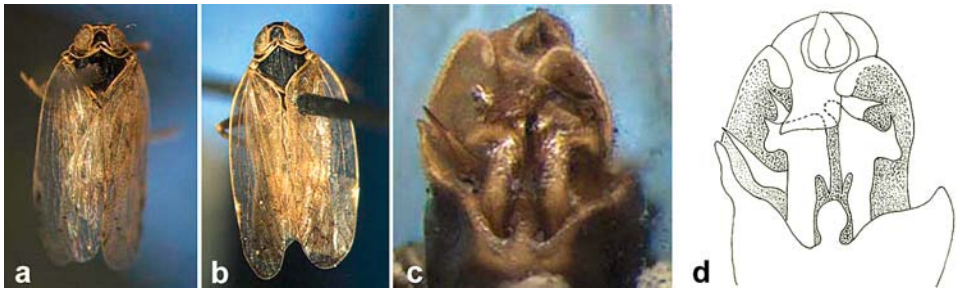


Fig. 9. Syntypes of *Cixius quinquecostatus* Dufour (= *R. melanochaetus auctt.*). a–b – habitus male and female respectively; c–d – male genital segment, ventral view.

Appendix 10.

Identity of *Reptalus limbatus* (Fieber)

The following figures of a male (no data, Puton coll., MNHN) are supplied by H. Hoch (see text). Two other specimens (Putton coll.) are also present: 1 ♂, no data; 1 ♀, 'Ciudad Real'.

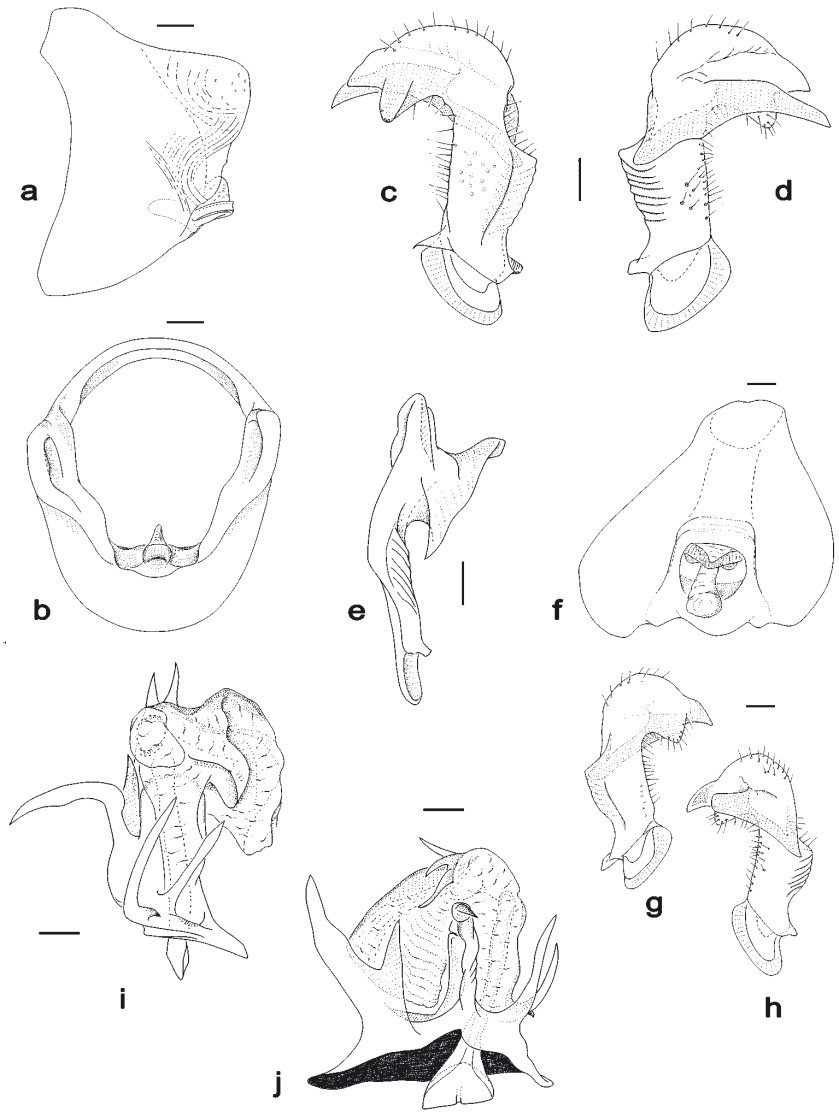


Fig. 10. Male genitalia of *Reptalus limbatus* (Fieber). a, b – pygophore; c–e, g–h – paramere; f – anal tube; i–j – aedeagus. Scale bars: 0.1 mm.

Appendix 11.

Key to genera of Cixiidae occurring in Britain

Note. In the British Handbook to Fulgoromorpha (Le Quesne 1960) the 12 species of Cixiidae were placed in two genera (*Oliarus* and *Cixius*). In the subsequent British checklist (Le Quesne & Payne 1981) one of these species (*C. pilosus* (Olivier)) was placed in *Tachycixius* and *C. borussicus* Wagner was synonymised with *C. cambricus* China, and an additional species, *Trigonocranus emmeae* Fieber, was included. However, these species are currently placed in five genera following Holzinger *et al.* (2003), which can be separated in the following key.

All male British specimens examined by us with five scutellar carinae and short head are here identified as *R. quinquecostatus* (second half of couplet 2). Similar females are assumed to be the same species. The only other cixiid with five scutellar carinae, *Pentastiridius leporinus*, has a longer head (compare Figs 11a and 11d).

1 Mesonotum with 5 carinae (Figs 11a, d–e). 2
– Mesonotum with 3 carinae. 3

2 Vertex longer than broad (Fig. 11a); 1st and 2nd hind tarsomeres with more than 10 apical teeth (Fig. 11b); styles without long inner spine. .... ***Pentastiridius* (*leporinus*)**
– Vertex shorter than broad (Fig. 11d–e); 1st and 2nd hind tarsomeres with no more than 8 apical teeth (Fig. 11c); styles with long inner acute spine (Fig. 11f). ..... ***Reptalus* (*quinquecostatus*)**

3 Outer apical margin of forewings with tubercles. .... ***Tachycixius* (*pilosus*)**
– Outer apical margin of forewings without tubercles. 4

4 Forewings clear, without black or brown markings; size < 4 mm. .... ***Trigonocranus* (*emmeae*)**
– Forewings with black or brown markings; size > 6 mm. .... ***Cixius*** (8 species)

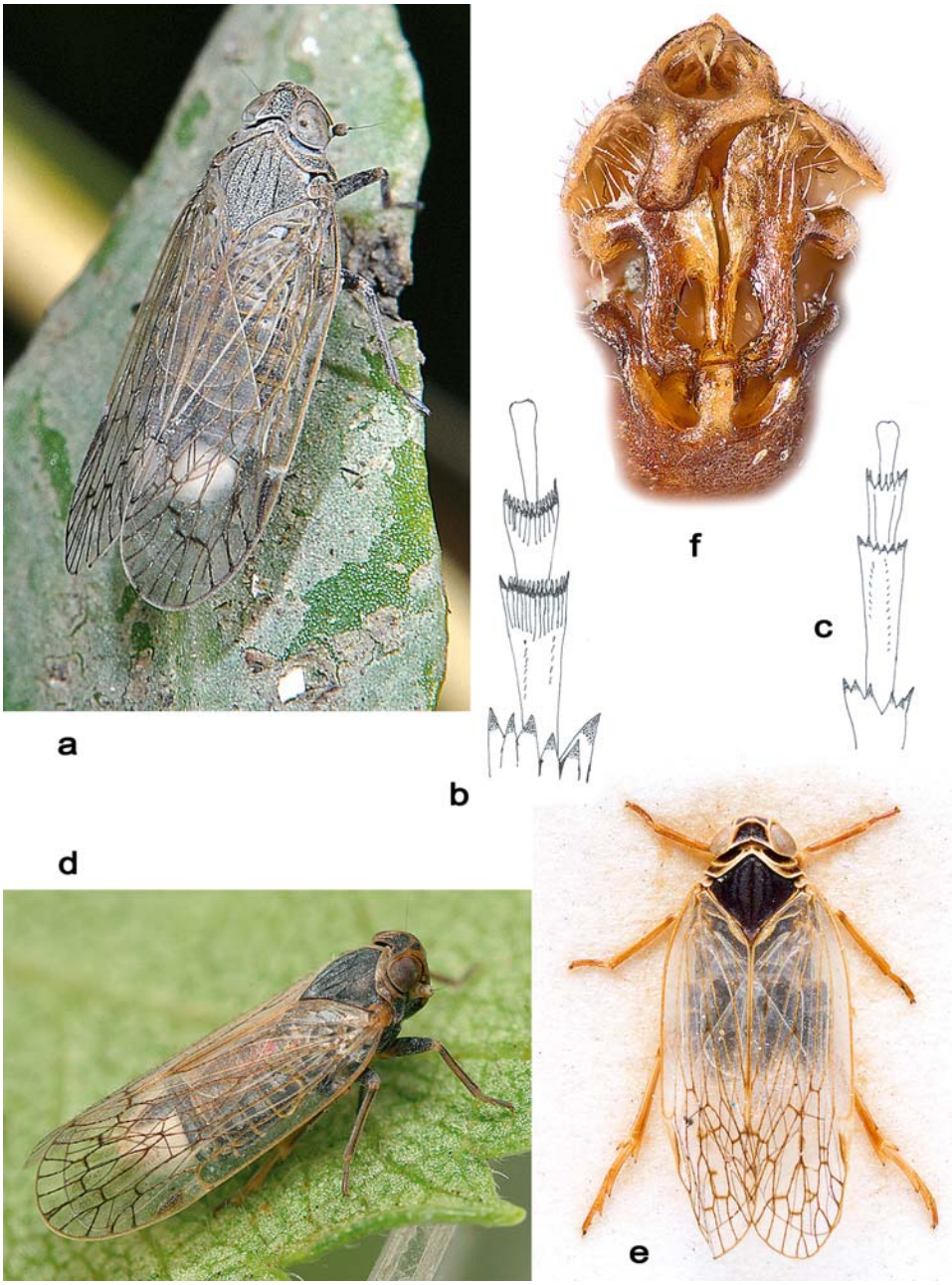


Fig. 11. Britsh Cixiidae. a–b – *Pentastiridius leporinus*, a – adult female (Paul Brock, 2011); b – apex of hind leg; c–d – *Reptalus qinquecostatus auctt.*: c – apex of hind leg; d – adult female (Tristan Bantock, 2011); e – adult male, Canvey Is. (BMNH); f – male genital capsule, caudal view.

Appendix 12.

Distribution and ecology of *Reptalus quinquecostatus* (of authors)

The discovery that all British material identified as *R. panzeri* is the same as the *R. quinquecostatus* of Continental European authors is all the more surprising given that the latter has only been recorded from central and southern Europe (Holzinger *et al.* 2003) and while there are numerous British records, Nickel (2003) notes that there are only six records for the whole of Germany, all confined to the northeast. *R. quinquecostatus* (of continental authors) is regarded as economically important as a potential vector of stolbur phytoplasma to both grapevines (Pinzauti *et al*. 2008) and maize (Bertin *et al*., 2010) in parts of central Europe, and so reliable identification is extremely important.

The following are the known continental records for *R. quinquecostatus*:

Austria: Holzinger (2009).
Bulgaria: Gjonov (2004).
Czech Republic: southern Moravia (Dlabola 1956, Lauterer 1957, Malenovský *et al.* 2011, Malenovský & Lauterer 2012).
France: 2 ♂♂ Rhone Valley, Chazay d'Azergues, vii.1995, W. della Giustina coll. (examined in the current study).
Germany: confined to upper Rhine plain and Franconia; Speyer, vii.1989, Staffelbach, vii.1949, Coburg, vii. 1950, Kitzingen, vii.1994, Gerolzhofen, viii.1994, Erlangen, vii.2001 (Nickel 2003).
Hungary: in saltmarshes (Nickel loc. cit.); in vineyards, Andornaktálya (Bertin *et al*., 2010).
Italy: widespread in sampled areas: Piemonte and Emilia Romagna (Bertin *et al*., 2010).
Romania: in potato fields, Fundulea, Baragon Plain and Csikszereda (Miercurea- Ciuc) (Bertin *et al*., 2010).
Serbia: abundant in carrot fields, Bačka; record could refer to additional species (Drobnjaković *et al.* 2010).
Slovakia: Dlabola (1954).
Slovenia: mostly on coastal shrubs and grass vegetation, vi. 2004, vii. 2001 and vii 2004 (Seljak 2004).
Turkey: Linnavuori (1965), Demir (2008).
Ukraine: Logvinenko (1975); Azov, S. Ukraine (Bertin *et al.* 2010).

In addition, Bourgoin (2013) cites records of *R. quinquecostatus* from Spain, Portugal and Greece. The extra-limital range of *R. quinquecostatus* apparently extends through central Asia east to China (Bourgoin 2013), however it has not been possible to verify the identity of specimens within Asia, and they are not included here, although it has recently been cited from Iran (Mozaffarian & Wilson 2011).

In contrast to continental Europe, the British records of *R. quinquecostatus* (as *R. panzeri*) are considerable. Also, all records are confined to southeast England, i.e. from Oxfordshire, Berkshire, Sussex, Surrey, Hampshire, the Isle of Wight, Essex and Kent (Le Quesne 1960, Kirby 1992) with the majority of records from Kent (Kirby 1992). More recently, *R. quinquecostatus* has been recorded from a number of sites in south London (Beckenham, Dulwich, Crystal Palace, Windsor Great Park) and in Sussex (Bexhill-on-Sea, Westfield, Billingshurst, Newhaven) (Jones & Hodge 1999). At one of the London sites (Crystal Palace, in July 1996) very high population densities have been recorded, with up to several hundred specimens present (Jones & Hodge 1999).

Recorded habitats for *R. quinquecostatus* in Britain include agricultural and fallow fields (Duffield 1963, Kirby 1992), urban parks, wood pasture, riverine meadows, brownfield sites (Jones & Hodge 1999) and coastal grazing levels (Ramsay 2009). In contrast the habitat data for continental European localities is limited but in Germany *R. quinquecostatus* is associated with scattered scrub and tall herbs on sand or loamy soils, whilst in Hungary the species is recorded on saltmarsh (Nickel 2003).

Although recorded from a variety of habitats, the overriding habitat preferences of *R. quinquecostatus* are for heavier soils which periodically dry out and surface crack, whilst retaining their moisture. This is presumed to be the mechanism by which females are able to access plant roots in the soil on which to lay their eggs. Cixiidae nymphs are soil dwelling and feed on roots and potentially fungi (Wilson *et al.* 1994).

Duffield (1960) noted that *R. quinquecostatus* (as *Oliarus panzeri*) was widely distributed in East and West Kent (southeast England) and for many years was abundant in one field at Brook (Kent), where in August it could always be swept and beaten from sallow. Duffield went on to say that the field used to crack badly which he thought gave the insects a place to oviposit, and that 'since the cracks have gone the insect has also gone, and has not been seen now for four years'. Similarly, Kirby (2001) suggested grasslands in Britain that are wet in winter but dry out and crack in summer as the preferred habitat of *R. quinquecostatus*, and a recently collected specimen by Ramsay was from the margin of brackish ditches in grazing levels, dominated by *Bolboschoenus maritimus* (Sea Club-rush), 29 July 2008 at Stoke Marshes, Isle of Grain, north Kent (TQ8575), a habitat which also cracks and dries out in the summer months. Of interest is that the closely related *Pentastiridius leporinus* was also recorded from the same site, the only recorded co-occurrence of these two species in Britain, although they co-exist widely in continental Europe (e.g. Bertin *et al.* 2010).

Whether *R. quinquecostatus* requires woody plants to complete its development as in many other cixiids (Wilson *et al.* 1994), is unclear, but it seems that they are not essential for longer term population survival given that populations of *R. quinquecostatus* can persist in grassy fields with no other vegetation present (Kirby 1992). Woody plants are often present in adjacent habitats and include *Salix* spp. (Duffield 1960, Edwards 1896), *Tamarix* spp. (Edwards 1896) and parkland trees (Jones & Hodge 1999), and it is likely that the polyphagous adults are 'vertical migrants' (e.g. Nickel 2003) onto taller hostplants, and have less exacting requirements than the nymphs.

Appendix 13.

The type concept

FIEBER's (1875) early comment on the 'types' he had examined (see Appendix 3b) prompted the following research on the subject of the first use of the word 'type' and how the type concept has changed over time. Much of the text is paraphrased from FARBER (1976) and VAN DER HAMMEN (1981). In the former work it is noted that the type concept during the first half of the nineteenth century was not a simple notion; it was used in at least three different ways: in classifications, collections and in morphology (see below).

The word 'type' itself is derived from the Greek noun *typos*, which originally referred to a mould (a hollow form or matrix). The term was used by Plato (427–347 B.C.) to mean either an impression, a model or an outline or survey. Similarly, in the Lexicon Philisocophicum by Johannes Micraelius (1597–1658) the term *typus* is defined as (1) the original model of which any resemblance is made and (2) an example signifying something beforehand, i.e. a symbol.

The word 'archetype' originally '*arche*' was referred to by Aristotle (284–322 B.C.) in the Metaphysics as the beginning, starting-point, foundation, origin, cause, directing principle or ruler, all having in common to be the first from which something either exists, or comes into being, or becomes known.

The word 'type' became replaced by 'archetype', as an example or the 'original' in the morphology type concept and was widely used in zoology (see 'Visualizing the Archetype' in WILLIAMS & EBACH 2008), reaching its pinnacle in the work of Richard Owen (1804–1892) in his development of the type-concept in comparative animal anatomy. The replacement of 'type' by 'archetype' could be connected with the introduction of 'type' in the rules for zoological nomenclature by the committee, appointed by the British Association for the Advancement of Science (see 1878 below), of which Owen was a member.

The following are important dates in the use of the word 'Type' in the classification and collection type concept.

1775, 1778

Before the nineteenth century only the classification type concept was used, sometimes implicitly. For example, in BUFFON's (1749–1789) ambitious project: a complete natural history of all the animals, in the sections on birds he firstly uses the word 'type' but latter does not, as follows:

1 "*Si l'on prend le rollier d'Europe pour type du genre…*"
"If we take the European Roller for type of the genus…" BUFFON (1775: 128).

2 "*Nous conserverons le nom générique de Gobe-mouche à celui d'Europe, comme étant généralement connu sous ce seul & même nom. D'ailleurs ce gobe-mouche nous servira de terme de comparaison pour toutes les autres espèces*."

> "We shall keep the generic name 'Flycatcher' for the European one, as it is generally known under this single name. Moreover, this flycatcher will serve for comparison with all other species". Buffon (1778: 517–518).

1801, 1802, 1804

Buffon's idea was developed by Lamarck (1801) and Latreille (1802, 1804). The former stated the following:

> "*Pour faire connaître d'une manière certaine les genres dont je donne ici les caractères, j'ai cité sous chacun d'eux une espèce connue…. Et j'y ai joint quelques synonymes que je puis certifier; cela suffit à me faire entendre*."
>
> "In order to make known, without a doubt, the genera of which I give here the characters, I have cited under each of them a known species .... And I have added some synonyms that I can attest; this is enough to make myself understood". Lamarck (1801: page viii of the 'Avertissement').

Latreille (1802) mentioned under each of his genera one or more species that were indicated as examples ('exemples'). On p. 64 of this work he characterized one of his examples moreover as the insect which had served him in the formation of the genus and later (Latreille 1804: 399) used the word 'type' ('Le genre gamase a pour type la mite des coléoptères de Geoffroi…'). Evidently, Latreille's types, as Buffon's before him, were selected as standards for comparison (a comparison enabling the conception of a model of the genus) in such a way that now constitutes the basis of type-species selection in modern systematic zoology.

1826

The 'idea' of a type in the sense of an original described specimen appeared in the early nineteenth century, e.g., Kirby & Spence (1826) gave the following advice when keying a specimen (added text in square brackets):

> "*When all these* [efforts] *fail, as they sometimes will, the dernier resort is a reference to the cabinet containing the original specimen from which the description was drawn…and thus many mistakes rectified, which would otherwise greatly mislead*". Kirby & Spence (1826: 553)

1828

The fact that the word 'type' was not in frequent use at this time, is reflected in its absence in most dictionaries of the first half of the nineteenth century. A notable exception is Noah Webster, An American Dictionary of the English Language (New York:

Converse, 1828), which gives this definition: 'In natural history, a general form, such as is common to the species of a genus, or the individuals of a species.'

1837

The further development of the type-concept in systematic zoology is closely connected with the development of rules for zoological nomenclature. This development dates back to a paper by STRICKLAND (1837); although type-species are not mentioned, according to Strickland's rule no. 18, families and subfamilies should be based on the most typical genus.

1838

The idea that a figure could serve the same purpose as the type specimen was demonstrated by BONAPARTE's (1838) comments on the magnificent bird illustrations that appeared at this time:

> "*Throughout the list I have quoted as Types of the Species under consideration, the figures of the great works*…" . BONAPARTE (1838: vi, preface).

1840

By 1840 there was near universal application of the classification type-concept as demonstrated by GRAY's (1840) catalogue title: 'A list of Genera of Birds, with an Indication of the Typical Species of Each Genus' and in the same year, WHEWELL (1840), stated the following (added text in square brackets):

> "*A Type is an example of any class, for instance, a species of a genus, which is considered as eminently possessing the characters of the class*" [In other words is typical of its group]. WHEWELL (1840: 494).

This is also an important date with regards to Westwood's 'Synopsis' and all the type designations therein, which led to an ICZN Opinion that the phrase 'typical species' in WESTWOOD (1840) should be construed as a type designation of a genus: International Commission on Zoological Nomenclature (ICZN 1941).

1842

A committee was appointed by the British Association for the Advancement of Science in 1842, to consider the rules by which zoological nomenclature might be established on a uniform and permanent basis. Strickland, Darwin and Owen were among the members of this committee. In its rules, published in 1843, type-species of genera are mentioned but not type specimens and in the 1878 edition (p. 7–8), the type-species is connected with the typical portion of the original genus.

1845

Similarly, the idea of 'fixing' a model or name carrier for a group was given by STRICKLAND (1845) in the following way:

> "*every specimen is separately enumerated with its locality and the name of its donor, which is especially important in a collection containing the type-specimens, from which original descriptions have been made..*" STRICKLAND (1845: 215).

> "*We may obtain a great amount of fixity, in the position at least, if not in the extent of our groups, by invariably selecting a type, to be permanently referred to as a standard of comparison..*" STRICKLAND (1845: 219).

1845

Another early mention of a type specimen was by Adam White (Assistant in the Zoology Department of the British Museum) who commented on "Gray's type specimen of *P. Fiendii* [Insecta: Coleoptera] from Mr. Children's collection" in the BMNH. WHITE (1845: 110).

1850

In a series of catalogues (from 1850) of the British Museums insect collection the importance of the data of individual specimens was noted in John Gray's Introductions. In those parts by Walker (e.g., WALKER's 1850), individual specimens with their data are actually indicated by issuing each with a different letter, a, b, c etc. The use of a similar lettering system in other catalogue parts denoted only a difference of locality or collections. Walker's system may have been the earliest enabling subsequent workers to know the actual number of specimens in the type series and hence, in the case of a single specimen, that what we now call a holotype had been designated.

1875

Further use of the word 'type' by FIEBER (1875) (see Appendix 3b under *Dr Mayr*, *Dr Redtenbacher* and *Dr Stål*).

1876

MCCOY (1876) is held to have designated a lectotype by referring to the cranium of a fossil marsupial as "the first described type of the species" (ICZN 1999: Article 74.6.1.2, under example).

1886

In the Code of Nomenclature adopted by the American Ornithologists' Union (1886) rules are given for basing species and subspecies on 'a type-specimen'.

1888

Although some type categories are credited to Thomas (see 1893 below) he noted that the use of 'co-type' was from C. O. Waterhouse. Although Thomas gave no date or reference for Waterhouse his assertion is supported by the fact that some John Scott British Hemiptera type specimens in the BMNH, London, from 1888, bear a 'co-type' label and which, it is assumed, were placed on the specimens by a museum curator under the instructions of Waterhouse, who worked at the museum between 1866–1910.

1893

The modern concept of a primary type is credited to THOMAS (1893), who gave suggestions for a more definite use of types and restricted the term 'type' to a single specimen and also introduced the terms 'paratype' and 'co-type' (= syntype) (but see 1888 above).

1896

A review of the rules of nomenclature, including the use of types, as used by entomologists at the end of the nineteenth century, was published by WALSINGHAM & DURRANT (1896).

1897

The realisation of the importance of type specimens can be deduced from the type catalogues that appeared in the second half of the 19th century and which were commented on by Strickland (see 1845 above) and later by SCHUCHERT (1897) in the following way:

> "*All naturalists concede that type-specimens constitute the most important material in a museum of natural history. The true appreciation of this fact, however, is of recent date, and is shown in numerous lately published catalogues of types possessed by different museums*…". SCHUCHERT (1897: 636).

Summary

The collection type-concept, although a technical concept, was not without its ambiguities. With regards to the type of a species, THOMAS (1893) summarised the situation, at that time, in the following way:

> "*The word 'type' itself when first introduced was meant to refer to the particular specimen (in the singular) originally described, but it soon was naturally applied to any individual of the original series, if more than one specimen was examined by the describer. In this there was little cause for confusion, but more recently it has been applied to any individual from the collection of the original author, obtained no matter*

> *how much later, and often not even determined by him as belonging to his species. Of late a still further cause of confusion has been introduced by certain authors who, obtaining specimens from the typical locality, have spoken of them as 'typical specimens', a method of reference which, although due to a praiseworthy regard for geographical exactness, is yet certainly liable to rise to inconvenience and confusion*".

With the growth of collections over time, taxonomists often had more than one specimen to use for descriptions of new species, and then could apply the word 'type' to more than one specimen. Conversely, sometimes a label saying 'type' was only put on one specimen when more than one specimen in the type series was present, while the word 'Holotypes' (for male and female) was used as late as 1930 by Pruthi in his material examined (Pruthi 1930)! Despite the frequent occurrence of the word 'type' on labels, this did not always go hand in hand with its use in the description, thereby allowing for the subsequent designation of a lectotype.

Obviously, the word 'type' meant different things to different people, and in time an entire nomenclature grew up such that Frizzel (1933) was able to list 233 uses for the term 'type' while Fernald (1939) added a few more usages and made the follow comment:

> "*The writer has been unable to learn who first completing his description attached to the specimen a label marked 'Type', Typical specimen or some other distinctive word or phrase. But whoever he was, he certainly raised the lid of Pandora's box, beginning the liberation of a list of terms now over one hundred in number*".

The emergence of the collection type-concept was also made possible by two developments of late eighteenth and early nineteenth-century natural history. The first of these was the invention of reliable taxidermic procedures. These techniques were especially critical in ornithology, where specimens could not easily be preserved in good condition. For those who assembled the early collections the preservation of some specimens was an impossibility, as noted by Réaumur (1747) in the following way:

> "*..ayant eu le déplaifir de les voir détruire journellement par des Infectes voraces, malgré les foins employez pour les défendre contre leurs dents*.."
>
> "I had the Mortification to see them every Day destroyed by ravenous Insects, in spite of all the care that had been taken to preserve them against their Teeth" (Réaumur 1748: 305)

By the early decades of the nineteenth century, however, the major problems had been solved and taxidermy had become part of the standard technical literature.

The second development that permitted the collection type-concept to emerge was the growth and proliferation of museum and other large collections that were accessible to researchers. Institutions, such as the BMNH and the Paris Museum, served as repositories for the enormous numbers of specimens sent back to Europe by explorers, collectors, and naturalists in the first half of the nineteenth century.