

## THE IDENTITY OF TWO FABRICIAN SPECIES OF AMARYGMINI (COLEOPTERA: TENEBRIONIDAE) FROM AUSTRALIA WITH A KEY TO SPECIES GROUPS AND SOME SPECIES OF *CHALCOPTEROIDES* STRAND<sup>1</sup>

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### Abstract

Lectotypes are designated for *Erotylus amethystinus*, F., 1775 and *E. tristis* F., 1788. The combination *Chalcopteroides amethystinus*, (F., 1775) is confirmed, the recombination *Chalcopteroides tristis*, (F., 1798) is established, and both species are redescribed. A key to species groups of *Chalcopteroides* Strand, and to species in the *tristis* species group is given. Two new synonymies are recorded: *Platolenes hydrophiloides* (Fairmaire, 1849) = *Amarygmus zelandicus* Bates, 1874; *Chalcopteroides prosciapiens* (Blackburn, 1893) = *Chalcopteroides boops* (Blackburn, 1899).

### Introduction

This paper originated from studies of the New Zealand Tenebrionidae. The New Zealand fauna of Amarygmmini comprises the single species *Amarygmus tristis* (F.) introduced from Australia (May 1963). A second species described from New Zealand, *Amarygmus zelandicus* Bates, is shown below to be based on a mislabelled specimen of the Pacific species *Platolenes hydrophiloides* (Fairmaire). Comparison with specimens in the British Museum (Natural History) (BM) confirmed that New Zealand specimens are conspecific with *A. tristis* as identified by T. Blackburn, H. J. Carter and K. G. Blair. However, perusal of the literature gave no indication that any of these entomologists, or H. Gebien, who had examined most Fabrician Tenebrionidae in the collection then housed at Kiel (Gebien 1906), had seen the type of *Erotylus tristis* F., 1798.

I was able to examine the type of this species in the Zoological Museum, Copenhagen (ZMKD). The specimen was very dirty, but bore a slight superficial resemblance to *Amarygmus tristis sensu* Blackburn, a relatively dull basically black species with metallic violet reflections on the elytra. I carefully cleaned the right side of the type, revealing brilliant metallic bluish violet elytra. Examination of the mandibles showed the apices to be broadly truncate. Clearly, *Erotylus tristis* is not an *Amarygmus* at all, but belongs to the large Australian genus *Chalcopteroides* Strand (= *Chalcopterus* Blessig).

Comparison with BM specimens showed that *C. tristis* is the species identified by Blackburn and Carter as *Chalcopterus amethystinus* (F.). Blair (1914) had already pointed out that the true *amethystinus* is specifically distinct from *C. amethystinus sensu* Blackburn and Carter. Fortunately Blair did not propose a new name for this latter species, which now takes the name *Chalcopteroides tristis*.

The species hitherto known as *Amarygmus tristis* appears on the basis of the BM collection to lack a name. However, it is not described at present as not all types of Australian Amarygmmini have been examined, and it is possible that the species has already been named but is not recognisable from the literature. In the meantime, if necessary, it can be referred to as *Amarygmus tristis sensu* Blackburn, 1893.

*Amarygmus zelandicus* Bates (1874) was described from New Zealand. I examined the holotype of this species (BM) and it proved to be a synonym of *Platolenes hydrophiloides* (Fairmaire, 1849.) syn. n. This species, although common on some tropical islands north of New Zealand (Fiji, Samoa, Tonga, Vanuatu, Solomons) has never been found in New Zealand. *P. hydrophiloides* is somewhat variable geographically. The holotype of *A. zelandicus* agrees well with specimens from Fiji, which is thus the most likely source of the specimen. It is concluded that this species does not occur in New Zealand and should be removed from the faunal list.

<sup>1</sup> Communicated by J. F. Lawrence

In this paper, *C. tristis* and *C. amethystinus* are redescribed, using characters found useful by previous authors plus new ones, and lectotypes are designated. Species groups within *Chalcopteroides* are defined on the basis of the structure of the last ventrite, and a key to groups, and to 14 species in the *tristis* group, is presented.

### *Chalcopteroides* Strand

*Chalcopteroides* Strand, 1935: 302.

*Chalcopterus* Blessig, 1861: 103 (non Reichenbach, 1852-Aves); Blackburn 1892: 411; 1893: 53-56; Carter, 1913: 6-13; 1926: 129.

Type species *Chalcopterus iridicolor* Blessig, 1861 (designated by Gebien, 1944).

This genus was originally established by Blessig (1861) on the basis of the mandibles, which are broadly truncate apically. In all other Amarygmini, the apex of the mandible is bifid, or at least there is a shallow apical notch (associated with a short exterior groove) between bluntly rounded apical teeth. The mandibular structure seems to be the only entirely reliable character for identification; however Blackburn (1893: 87-89) gave correlated characters useful for distinguishing most *Chalcopteroides* from most *Amarygmus*.

In *Chalcopteroides* (and in the Australian species of *Amarygmus*) the aedeagus is normally oriented within the abdomen, i.e. the tegmen is dorsal in position. According to Ardoin (1962-69), the aedeagus is inverted in African Amarygmini. The aedeagus of *Chalcopteroides* resembles those of African genera in being asymmetrical, with the base of the tegmen twisted to the right (Fig. 1). In tenebrionids the orientation of the aedeagus is normally of high systematic value, but in the African Amarygmini the position of the aedeagus appears to be of no more than generic importance.

In *Chalcopteroides* the female genitalia resemble those of other Amarygmini in having a branched spermathecal accessory gland (SAG, Fig. 3). Baculi of the paraprocts are very long and lie in pockets of the intersegmental membrane projecting into the abdomen (see also Tschinkel and Doyen 1980, Fig. 48).

Gut contents of the single specimen of *C. tristis* examined contained plant material, including numerous fungal hyphae and spores.

Defensive glands resemble those of other Amarygmini (e.g. Tschinkel and Doyen 1980, Fig. 11). Reservoirs are large, elongate, without common volume, with a strongly transversely folded surface and a constriction at about mid-length. Gland tubules enter along a single basal line on each reservoir.

Larvae of *Chalcopteroides* have short urogomphi borne on a process projecting obliquely upwards (Watt 1974), and tergite 9 is otherwise convex. In these respects they differ from all other known larvae of Amarygmini (e.g. *Meracantha contracta* (Beauvoir), cf. Boving and Craighead 1931; *Amarygmus morio* (F.), cf. Spilman 1966; *Plesiophthalmus* spp. and *Exilota curva* Marseul cf. Hayashi 1980, P1. 25). At least some *Chalcopteroides* larvae are soil-inhabitants, whereas known *Amarygmus* larvae live in rotten wood.

Gebien (1942-44: 842-847) listed 113 supposed valid Australian species of *Chalcopteroides* (plus 5 from the Papuan area). Both Blackburn (1893) and Carter (1913) gave keys to most of these, but the keys are very artificial and some of the characters used are unreliable. Carter's first division, separating the species into 2 subequal groups, is "pronotum black" versus "pronotum metallic or coloured". Although many species fall definitely into one group or the other, there are a number with a basically black pronotum with individually variable weak metallic reflections. Another disadvantage in using this character first in the key is that some species which appear to be closely related in everything except the colour of the pronotum, are widely separated in Carter's system.

Neither Blackburn nor Carter used the structure of the last ventrite (i.e. the last visible abdominal sternite, morphologically sternite 7) in their keys or descriptions. In some species, including *C. tristis* and *C. amethystinus*, the last ventrite in both sexes has a distinct narrow groove, near and parallel to the hind margin. In all species having

this marginal groove there are also 2 oblique areas (sometimes almost merging medially) of coarse punctures in front of it, each bearing a coarse, backwardly-inclined seta. As a tentative hypothesis I regard all species with a marginal groove on the last ventrite as members of a monophyletic group (*tristis* species group) defined by this character. In all these species, the elytral "striae" are represented by rows of punctures without interconnecting depressions, the intervals are quite flat, and the interstitial punctures fine. The ocular sulcus (see Blackburn 1893) is indistinct or absent.

A second group of species (*setosus* species group) has 1 or 2 areas of coarse punctures bearing coarse setae on the last ventrite. This group, which contains many more species than the *tristis* species group, may also be monophyletic. Functionally the coarse punctures could contain orifices of glands and the coarse setae may be concerned with dissemination of the secretion (possibly an aggregation pheromone). The marginal groove may also be involved in distribution of secretions. Hopefully somebody in Australia with ready access to the living insects will investigate these structures further.

The following key is based on examination of type material of Blackburn, Fabricius, Hope and Pascoe species, and specimens of species of other authors determined by Blair and Carter. I have not seen identified material of the following 15 species: *augusticollis* (Carter), *cyaneus* (Carter), *doddi* (Carter), *elongatus* (Carter), *gilesi* (Carter), *grandis* (Macleay), *interrogationis* (Gebien), *michaelseni* (Gebien), *nitidus* (Carter), *parallelocollis* (Gebien), *praetermissus* (Carter), *rugosicollis* (Macleay), *sericatus* (Carter), *tenuicornis* (Gebien), *torpedo* (Carter). It is possible that one or more of these belong to the *tristis* species group. No known extra-Australian species fall into the *tristis* species group.

**Key to *Chalcopteroides* species groups and some species of the *tristis* group**

1. Last ventrite of abdomen lacking coarse punctures, coarse setae and marginal groove . . . . . **iridicolor** species group (not keyed further).  
 Last ventrite of abdomen with 1 (broad median) or 2 (medio-lateral) areas of coarse punctures towards hind margin, each of which bears a long, coarse, backwardly inclined setae . . . . . 2
2. Last ventrite of abdomen with a distinct marginal groove just before and parallel to the hind margin, extending for most of width of the ventrite (*tristis* species group) . . . . . 3  
 Last ventrite of abdomen without marginal groove (*setosus* species group) (not keyed further).
3. Eyes separated dorsally by the width of 2 facets or less.  
 Elytra with coppery reflections . . . . . 4  
 Eyes separated dorsally by width of much more than 2 facets.  
 Elytra usually without coppery reflections . . . . . 5
4. Pronotum black, less strongly transverse, length/width not exceeding 1.50, posterior angles narrowly rounded. Elytral interstitial punctures larger, more than half diameter of strial punctures. Body 14.3-15.5 × 6.3-6.6 mm [Western Australia] . . . . .  
**proscipiens** (Blackburn, 1893)  
= *boops* (Blackburn, 1899). Syn. n.  
 Pronotum metallic, more strongly transverse, length/width exceeding 1.60, posterior angles more broadly rounded. Elytral interstitial punctures smaller, less than half diameter of strial punctures. Body 14.8 × 6.6 mm [Queensland] . . . . .  
**ocularis** (Blackburn, 1893)
5. Pronotum and elytra black, underside black. Form elongate, length/width exceeding 1.9. Body 11.4 × 5.1 mm [northern Australia] . . . . . **bovilli** (Blackburn, 1892)  
 Elytra and usually pronotum metallic, underside black or metallic.  
 Form often less elongate . . . . . 6
6. Form very elongate, length/width exceeding 2.2 . . . . . 7  
 Form less elongate, length/width not exceeding 2.0 . . . . . 8

7. Strial punctures oval, irregularly distributed. Tarsal vestiture light reddish-yellow. Body 11.2-11.4 × 4.8-5.1 mm [north Queensland] . . . . . **gracilior** (Blackburn, 1893)  
 Strial punctures circular, smaller, regularly distributed. Tarsal vestiture very dark reddish. Body 10.2-11.1 × 4.8-5.1 mm [northwest Australia] . . . . . **scutellaris** (Carter, 1921)
8. Femora, and sometimes tibiae, red. Vestiture of hind tarsi black, of front and middle tarsi dark red. Body 8.9-11.9 × 4.7-5.8 mm [eastern Queensland] . . . . . **tristis** (F., 1798)  
 (amethystinus auctorum)
- Legs black. Vestiture of tarsi uniform in colour, that of hind tarsi not notably darker than remainder . . . . . 9
9. Last ventrite with a pair of well-defined anterior transverse depressions delimiting a longitudinal median raised area. Body 11.7 × 5.8 mm [Queensland] . . **palmerstoni** (Blackburn, 1892)  
 Last ventrite evenly convex anteriorly, without well-defined depressions . . . . . 10
10. Elytra highly polished, brilliantly metallic bluish-violet, without any trace of microsculpture at 50x magnification. Body 13.6-15.1 × 7.5-8.3 mm [South Australia] . . **iridescens** (Carter, 1913)  
 Elytra less highly polished, microsculpture clearly visible at 25x magnification . . . . . 11
11. Pronotum black, surface dull, microsculpture very strong. Large, body length exceeding 14 mm . . . . . 12  
 Pronotum metallic, surface somewhat shining, microsculpture weaker. Smaller, body length less than 14 mm . . . . . 13
12. Pronotum strongly transverse, length/width exceeding 1.9. Elytra with coppery reflections. Body 15.1-18.7 × 8.5-10.0 mm [northwest Australia] . . . . . **velutinus** (Macleay, 1827)  
 Pronotum less transverse, length/width not exceeding 1.8. Elytra with greenish reflections. Body 14.6 × 7.7 mm (northwest Australia) . . . . . **obscurus** (Blackburn, 1892)
13. Scutellum shining, distinctly punctate. Body 11.6-11.8 × 5.6-5.8 mm [north Queensland] . . . . . **amethystinus** (F., 1775)  
 Scutellum dull, with stronger microsculpture, impunctate . . . . . 14
14. Anterior marginal groove of pronotum distinctly impressed throughout. Sides of pronotum weakly curved; elytra at least 1.6 times as wide as pronotum. Body 12.4-12.8 × 6.5-6.8 mm [north Queensland] . . . . . **bellus** (Blackburn, 1892)  
 Anterior marginal groove of pronotum completely effaced in middle. Sides of pronotum more strongly curved; elytra no more than 1.5 times as wide as pronotum . . . . . 15
15. Strial punctures about same diameter as eye facets. Interstitial punctures of elytra scarcely visible at 10x magnification. Body 12.2-13.3 × 6.3-6.8mm [north Queensland] . . **pulcher** (Blackburn, 1893)  
 Strial punctures about twice diameter of eye facets. Interstitial punctures of elytra clearly visible at 10x magnification. Body 12.4 × 6.3 mm [southwestern Australia] . . **mimus** (Blackburn, 1892)

Although the *setosus* species group was not keyed further (see couplet 2) it has been determined that the following 43 species belong to the *setosus* species group as defined here: *acutangulus* (Blackburn), *brevipes* (Blackburn), *caesar* (Carter), *costatus* (Blackburn), *croesus* (Blackburn), *cyaniventris* (Carter), *cylindricus* (Blackburn), *difficilis* (Blackburn), *exoletus* (Blackburn), *imperialis* (Blackburn), *inconspicuous* (Blackburn), *interioris* (Blackburn), *iris* (Blackburn), *kochi* (Blackburn), *latifrons* (Carter), *leai* (Blackburn), *lepidus* (Blackburn), *longipennis* (Hope) = *similis* (Blackburn), *longiusculus* (Blackburn), *longulus* (Blackburn), *lucidus* (Carter), *macer* (Blackburn), *mastersi* (Blackburn), *major* (Blackburn), *maximus* (Blackburn), *mercurius* (Blackburn), *mundus* (Blackburn), *murrayensis* (Blackburn), *nobilis* (Blackburn), *palmerensis* (Blackburn), *perforans* (Gebien), *prismaticus* (Carter),

*proditor* (Carter), *puncticollis* (Hope), *punctipennis* (Macleay), *punctulatus* (Blackburn), *rugosipennis* (Macleay), *segnis* (Blackburn), *setosus* (Blackburn) = *cupriventris* (Carter), *superbus* (Blackburn), *viridicollis* (Macleay), *yorkensis* (Blackburn), *zonatus* (Blackburn).

***Chalcopteroides tristis* (F.), comb. n. Figs 1-3**

*Erotylus tristis* F., 1798:102; Zimsen 1964:116 (no. 1804)

*Cnodulon tristis* F., 1801,2:13; Zimsen, 1964:116 (no. 1804)

*Chalcopterus amethystinus sensu* Blackburn, 1889:1435, misidentification; 1893:66; Carter 1913:10,31

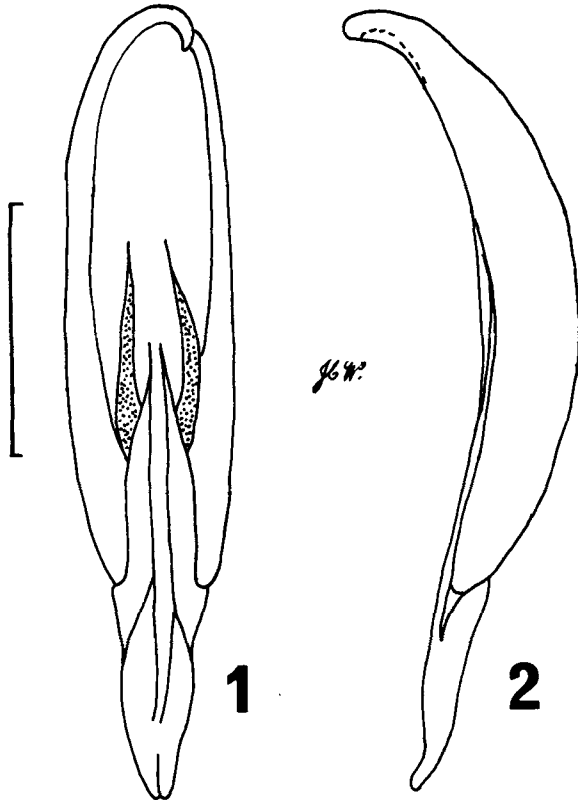
*Type*—*Lectotype* ♂ (not dissected): *tristis* [Fabricius] LECTOTYPE ♂, *Erotylus tristis* Fabr. (*Chalcopteroides*), det J. C. Watt, 1985/Cnodulon triste F., Holotype Kiel II. 13.4, 15/85/OM [typed label in unit pinning tray] 11.0 × 5.8 mm (estimate, elytra spread, ZMKD).

*Other material examined*—Specimen labelled "*smaragdulus*", Fabrician Collection, ZMKD; QUEENSLAND: Cooktown, Mareeba, Cairns, Ravenshoe Road, Hot Springs, Riton, Gogonga, Davies Creek, Alamaden, Chillagoe district, Rockhampton, Brisbane. NORTHERN TERRITORY: Port Darwin. Dec, Jan, Feb, Mar. (BMNH, ANIC).

**Redescription**

Moderately elongate, oval, length/width 1.90-1.95, convex. Antennae and head black, latter often with slight metallic reflections, pronotum dull metallic Prussian blue or sometimes greenish blue, elytra usually bright metallic bluish violet, sometimes greenish blue, underside black (except for hypomera and epipleura, which are variably metallic), femora light red or reddish brown, tibiae reddish to almost black, tarsi black or dark brown, front and middle tarsi clothed below with dark reddish coarse pubescence, hind tarsi clothed below with coarse black pubescence.

Antennae with segments 7-11 distinctly broader than basal segments. Head fairly evenly punctured, diameter of punctures less than facets of eyes, microsculpture scarcely or not visible at 25x magnification. Upper part of eye with a weakly defined sulcus along inner margin. Pronotum with sides moderately curved, anterior and lateral grooves distinctly impressed throughout; microsculpture strong, clearly visible at 25x magnification, evenly punctured, punctures larger than those of head but diameter less than facets of eyes.



FIGS 1-2—*Chalcopteroides tristis* ♂, north Queensland, aedeagus: (1) ventral view; (2) lateral view (dorsal on right). Scale line = 1 mm.

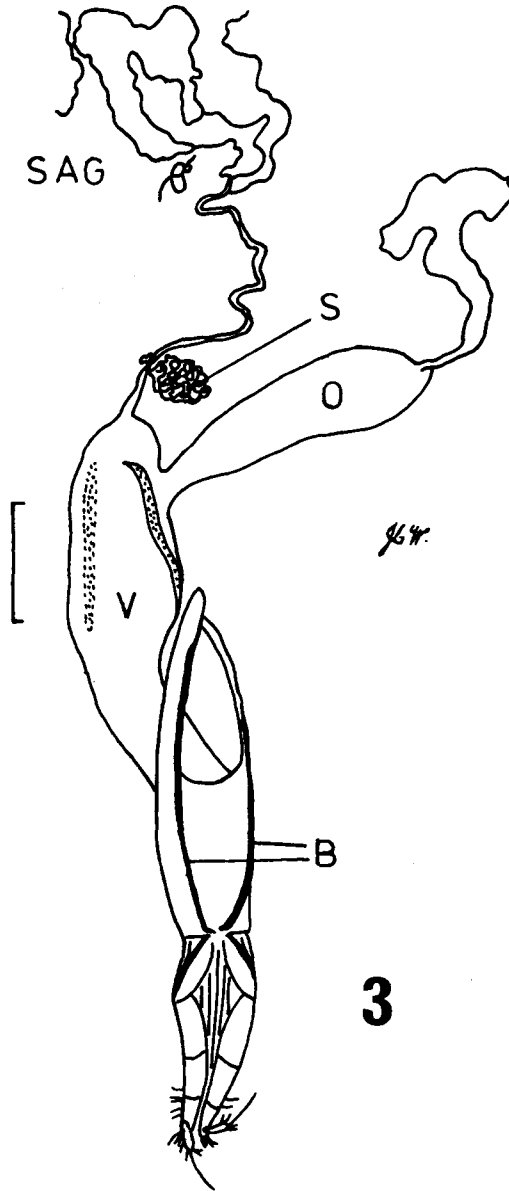


FIG. 3—*Chalcopteroides tristis* ♀, north Queensland, genitalia, ventral view. Note longitudinal sclerotisations in wall of vagina. B, baculi; O, oviduct; S, spermatheca; SAG, spermathecal accessory gland; V, vagina. Scale line = 1 mm.

Scutellum black, impunctate, dull, microsculpture finer than that of pronotum. Elytra elongate oval, with rows of punctures whose diameter mostly exceeds that of eye facets; interstitial punctures variable; in the lectotype subequal to pronotal punctures; in some other specimens much finer; microsculpture weaker than that of pronotum, but clearly visible at 25x magnification.

Prosternum with anterior keel rounded, not prominent. Posterior keel of prosternal intercoxal process prominent, angular (often partly obscured by mesosternum). Undersurface generally with very fine or obsolete punctures, except last ventrite, on which there is on each side an oblique group of coarse punctures, each of which bears a coarse, backwardly inclined seta (occasionally rubbed off). Last ventrite with deeply impressed marginal groove. Hind femora slightly expanded on inner side in apical half in male, but difference not sufficiently marked to permit reliable sexing.

Male and female genitalia as illustrated (Figs 1-3).

Body 8.9-11.9 × 4.7-5.8 mm.

### Notes

The lectotype is almost complete, lacking only its left middle leg, but it was covered with dirt, and consequently appeared quite dull. I have carefully cleaned the right-hand side, revealing the brilliant metallic bluish violet of the elytra. Presumably the specimen must have been dirty when described by Fabricius, as he named it *tristis* (meaning sad or dull-coloured).

The original description did not state the number of specimens on which it was based. Only one specimen was mentioned by Zimsen (1964), but it has been designated as lectotype rather than holotype because another specimen of *tristis* exists in the Fabrician Collection, ZMKD. This second specimen bears the label "*smaragdulus*" in Fabricius' own hand. I have compared the specimen with the holotype of *smaragdulus* in the Banks Collection (BM). There is a superficial resemblance in body colour, but otherwise there are numerous differences. Probably most important is the last ventrite, which in *smaragdulus* is uniformly, finely punctate and lacks a marginal groove (placing the species in the *iridicolor* species group of my classification).

Although *tristis* was not described until 1798, it was probably collected on Cook's first voyage (in HMS Endeavour). In his description of *Chalcopteroides amethystinus*, Fabricius (1775) stated: "femoribus interdum rufis". In the type of *C. amethystinus* in the Banks Collection (see below), the legs are uniformly black. It seems probable that Fabricius based his description of *amethystinus* on 3 specimens, 2 of which he retained himself, later describing one as *tristis*, and misidentifying the other (probably on its colour) as *smaragdulus*.

*C. tristis* occurs in coastal localities from the vicinity of Brisbane to far northern Queensland, and at Darwin. In the lectotype and in specimens from the far north, only the femora are red, the tibiae being black. In specimens from the south of the range (Rockhampton, Brisbane), the tibiae are also red. In the lectotype and in specimens from the far north the elytral interstitial punctures are larger than in specimens from further south, in which they are very fine.

The only place in the far north of Queensland where the Endeavour called was the Endeavour River, Cooktown. A specimen from Cooktown (ANIC) is almost identical with the lectotype, but most of the coarse setae on the last ventrite appear to have been rubbed off. Thus it is probable that Endeavour River, Cooktown is the type locality for *C. tristis*.

Very few species of *Chalcopteroides* have reddish femora. *C. tristis* is readily distinguished from all of these by the marginal groove and areas of coarse punctures and pubescence on the last ventrite, and also by the prominent posterior angular keel on the prosternal intercoxal process (often partly obscured).

### **Chalcopteroides amethystinus (F.)**

*Erotulus amethystinus* F., 1775:124; Zimsen, 1964:116.

*Nodulon amethystinum* F., 1801,2:13; Zimsen, 1964:116.

*Helops amethystinus*: Olivier, 1795:3, 58, p.9, Pl.1 fig. 9; Boisduval, 1835:273.

*Chalcopteris amethystinus*: Blair, 1914:489; Radford 1981:162-3.

*Chalcopteroides amethystinus*: Gebien, 1944:846.

Type—Lectotype ♂, Type [Printed in red circle]/*Erot. amethystinus* Fab. Entom. p.124 n.7/LECTOTYPE ♀, *Erotulus amethystinus* F. (*Chalcopteroides*) det. J. C. Watt, 1985. 12.2 × 5.8 mm. (estimate elytra spread) Banks Collection, BM.

*Other material examined*—QUEENSLAND: 1 specimen, no other data in BM.

### Redescription

Moderately elongate, oval, length/width 1.93-1.97. Antennae and head black, with slight metallic reflections between eyes, pronotum dull metallic greenish blue, elytra shining metallic greenish violet, underside black, tarsal vestiture black.

Antennae with segments 7-11 slightly broader than basal segments. Head evenly, fairly finely punctured, punctures about half diameter of eye facets (punctures behind eyes much larger, almost confluent, not usually visible in mounted specimens), microsculpture moderate, just visible at 25x magnification, interocular distance equal to about 10 facets (0.4 mm). Ocular sulcus weakly defined. Pronotum with sides more strongly

curved than in *tristis*, *bellus*, *mimus* or *pulcher*, width/length 1.50-1.52, anterior and lateral grooves distinctly impressed throughout; microsculpture strong, clearly visible at 25x magnification, punctuation even, punctures larger than those of head, diameter less than facets of eyes. Scutellum black, shining, microsculpture weak, distinctly but sparsely punctured. Elytra elongate oval, with rows of punctures whose diameter exceeds that of eye facets, interstitial punctures finer than those of pronotum; microsculpture somewhat weaker than that of pronotum, but clearly visible at 25x magnification.

Prosternum with anterior keel rounded, not at all prominent. Posterior of prosternal intercoxal process rounded off, not angular. Undersurface generally with very fine or obsolete punctures except on last ventrite, on which there is on each side an oblique group of coarse punctures, each of which normally bears a coarse, backwardly inclined seta (rubbed off in lectotype). Last ventrite with deeply impressed marginal groove.

### Notes

Unfortunately this species is known to me from only two specimens. The Banks Collection type, although apparently unique, is designated as lectotype because the original description was probably based on a mixed series of *amethystinus* and *tristis* (q.v.). The lectotype was certainly collected on Cook's first voyage to Australia, and as with *C. tristis*, Endeavour River, Cooktown is the probable type locality.

The specimen in ZMKD listed as *amethystinus* by Zimsen is a species of *Platydemia* Laporte and Brullé. It is labelled as *amethystinus* in Fabricius' own handwriting. It is difficult to believe that Fabricius made a misidentification of this magnitude (the species differ in size, convexity, shape, colour, antennae, legs, very obviously to the naked eye: there are several quite obvious discrepancies between the description of *amethystinus* and the Kiel specimen so labelled). It seems very probable to me that the label was switched during recuration at Kiel, which is already known to have happened in other instances (Zimsen, 1964).

### Acknowledgments

I thank Mr P. M. Hammond and Mr R. D. Pope (BM) for facilities, equipment and use of the collection; Mr O. Martin (ZMKD) for loan of Fabrician specimens; and Dr J. F. Lawrence, Division of Entomology, CSIRO, Canberra for loan of specimens. The work done in Europe in 1985 was supported by a New Zealand DSIR Study Award. To facilitate further work on Amarygmmini in Australia, specimens found to compare closely with the lectotypes were labelled as such with conspicuous yellow labels.

I also thank the Australian Entomological Society for waiving page charges.

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[Manuscript received 7 June 1988.]