

Definition and description of larval types of *Cyaneolytta* (Coleoptera Meloidae) and new records of their phoretic association with Carabidae (Coleoptera)

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The hypothesis of a general phoretic association of *Cyaneolytta* Péringuey 1909 triangulins (Meloidae) with Anthiini (Carabidae) is supported by many new records from several regions of Africa and India. Four morphological larval types of *Cyaneolytta* are described and some morpho-species belonging to different morphotypes are identified and illustrated.

KEY WORDS: Coleoptera, Meloidae, Carabidae, *Cyaneolytta*, phoretic association, larval morphological variation.

Introduction	166
Material and methods	167
Description of larval morphotypes of <i>Cyaneolytta</i>	167
Key to the <i>Cyaneolytta</i> morphotypes	174
Remarks on the <i>Cyaneolytta</i> larval biology	174
Acknowledgements	177
References	177
Appendix 1: List of new records and other previously studied specimens	178
Appendix 2: List of the Carabidae species recorded as vectors of <i>Cyaneolytta</i> triangulins	186

INTRODUCTION

Meloidae is a beetle family including more than 2500 species widely distributed in temperate and tropical areas. They are characterised by hypermetabolic metamorphosis, parasitoid biology and defensive behaviour linked to cantharidin production. The larvae of the primitive subfamily Eleticinae are not parasitic but probably have predatory habits instead (PINTO et al. 1996, BOLOGNA et al. 2001). The larval morphology and biology were largely incorporated in the classification of the family. Most blister beetle genera (excluding Eleticinae) have a planidial first instar larva (named triungulin), which develops by feeding on provisions and larvae of Apoidea or other aculeate Hymenoptera, or on eggs of Orthoptera Acridoidea (some genera of the tribes Epicautini and Mylabrini) (see BOLOGNA 1983, 1991 for a review).

The adaptation to phoresy on bee hosts or on occasional vectors visiting flowers (used by triungulins for the first phase of dispersion), or also on carabids in a single genus (*Cyaneolytta* Péringuey 1909), resulted in the independent attainment of several anatomical features, e.g. the heavily sclerotised and flattened body, and modifications of the head and legs which assist the larva in grasping the setae of its host (MACSWAIN 1956, SELANDER 1985). Similar modifications occur in the phoretic first instar larvae of the family Rhipiphoridae. The similarity in phoretic characters of some taxa supported several previous classifications of Meloidae (MACSWAIN 1956, SELANDER 1985, BOLOGNA 1991). A recent cladistic analysis of this beetle family resulted in a new phylogenetic classification suggesting that phoresy evolved separately several times in the subfamily Meloinae, and also in the subfamilies Tetraonycinae and Nemognathinae (BOLOGNA & PINTO 2001).

Phoresy on Carabidae Anthiini was first cited by GERSTAECKER (1873), CROS (1937) and BLAIR (1943), without identification of the meloid parasitoid. This association was clarified by BOLOGNA et al. (1990), who hypothesized a regular phoretic association between the first instar larvae of the genus *Cyaneolytta* and these carabids. They also described the triungulin of *C. depressicornis* (Laporte de Castelnau 1840), that of two other undetermined species and of another undetermined meloine taxon, which BOLOGNA & PINTO (2001) later referred to *Cyaneolytta*. SELANDER (1987) described the triungulin of *Cyaneolytta fryi* (Wollaston 1861), which greatly differs morphologically from that of other congeneric species probably due to its parasitism on bees. According to their recent phylogenetic analysis, BOLOGNA & PINTO (2001) removed the genus *Cyaneolytta* from the tribe Meloini, where it was placed by SELANDER (1987) and BOLOGNA (1991), and tentatively allied it with Epicautini, which includes genera predaceous on grasshopper eggs (see BOLOGNA 1991 for a review).

BOLOGNA et al. (1990) identified seven carabid species as regular vectors of *Cyaneolytta* triungulins: they belong to Anthiini (genera *Anthia* Weber 1801, *Chilanthia* Obst 1901, *Termophilum* Basilewsky 1950, *Cypholoba* Chaudoir 1850) and Panaegeini (single genus *Psecadius* Alluaud 1911). These authors also formulated some hypotheses about this phoretic association, focusing on the possible parasitic or predatory biology of *Cyaneolytta* on termites, ants, grasshoppers, or carabid eggs.

The aims of the present paper are: (i) to support the hypothesis of a regular association between *Cyaneolytta* larvae and Anthiini by means of a large number of new records from the whole range of the genus (subsaharan Africa and India); (ii) to expand the knowledge of Anthiini vectors by adding about 15 species; (iii) to define four morphological types of *Cyaneolytta* triungulins to which can be referred several morpho-species.

MATERIAL AND METHODS

The following collections of Carabidae were examined: A. Casale, Torino, Italy (AC); A. Vigna Taglianti, University of Roma "La Sapienza", Italy (AVT); "La Specola" Zoological Museum, University of Florence, Italy (MF); Muséum National d'Histoire Naturelle, Paris, France (MNHN); Entomological Museum, University of California, Riverside, USA (UCR).

Cyaneolytta larvae were detected (with a stereomicroscope), attached to different body regions of dried preserved carabids. Some 459 first instar larvae were studied (see Appendix 1); they are preserved in the M.A. Bologna collection, University "Roma Tre", Italy (CAB) and in the MNHN collections; some triungulins from CAB are now preserved in the J.D. Pinto collection at UCR. A few triungulins now in CAB were found in the Meloidae collections of the Museo Zoologico dell'Università "La Specola", Firenze, Italy (MF), and the Transvaal Museum, Pretoria, South Africa (TM). Other previously described triungulins were re-examined (see Appendix 1).

Eggs of *Cyaneolytta granulipennis* (Laporte de Castelnau 1840) from South Africa (ex Bophuthatswana, Pilanesberg National Park, 1000 m, 9.XI.1993, P. Audisio leg. layed 10.XI.1993; vial P241, stub 91, CAB) were examined.

Larvae removed from carabids with a small brush and eggs obtained from rearing were immediately preserved in 70% ethanol. Morphological analyses utilized an Olympus SZX 12 stereomicroscope and Leitz Laborlux S light microscope (both equipped with a drawing tube) to examine cleared specimens mounted on slides in Canada balsam (CAB) or Euparal (MNHN), and a Philips XL30 scanning electron microscope for material mounted on stubs after critical point dehydration and gold sputtering.

DESCRIPTION OF LARVAL MORPHOTYPES OF *CYANEOLYTTA*

Only triungulins of *C. fryi* and *C. depressicornis* are known as hatched from eggs (SELANDER 1987, BOLOGNA et al. 1990). As previously indicated, BOLOGNA et al. (1990) described two additional undetermined species related to *depressicornis* and a morphologically well distinct species (cited as "Meloini indet."), which was referred to *Cyaneolytta* by BOLOGNA & PINTO (2001).

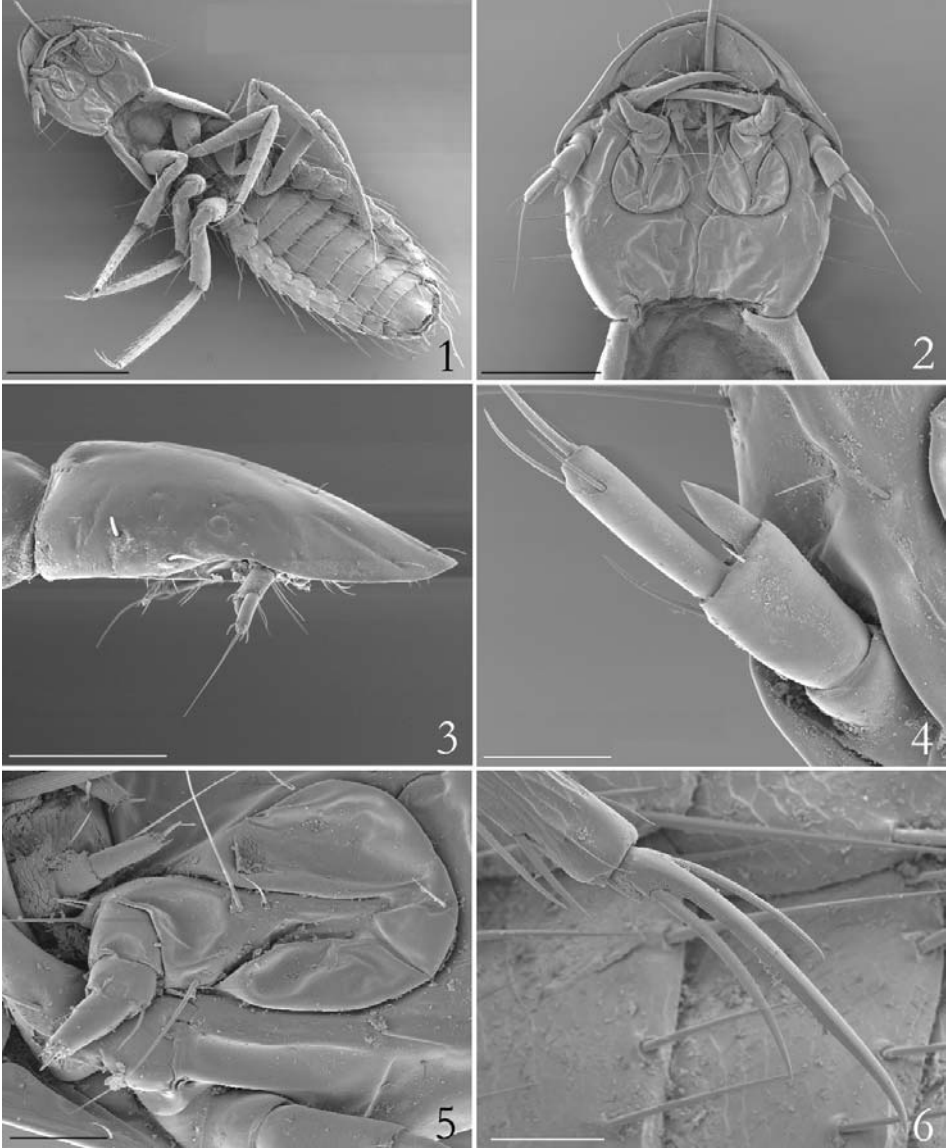
The specimens obtained from eggs or found on vectors can be divided into four distinct morphotypes (species groups) on the basis of derived characters (see Appendix 1). This larval polymorphism, as in other phoretic genera such as *Meloe* Linnaeus 1758 (see DI GIULIO et al. 2002), probably suggests different parasitic specialisation and hosts. Some proposed morpho-species probably include more than one species. These four morphotypes probably do not correspond to the numerous species groups phenetically defined by KASZAB (1953) on adults, and also adopted by SELANDER (1986).

These four larval groups were partially recognised by BOLOGNA et al. (1990) and by BOLOGNA & PINTO (2001), and are easily identified by characters listed below. The *depressicornis*, *coerulea* and "Sahelian" groups have several characters in common, denoting possible phylogenetic relationships. The *fryi* group is apparently monotypic and well differentiated by some autapomorphic traits. The "Sahelian" group is most similar to the *fryi* group.

With one exception, species names cannot be proposed for the triungulins found on carabids. In the case of the Indian larvae the collection localities, all in the Orissa state, strongly support an association with *C. coerulea* (Pfaff 1824), the only species recorded in this state (SELANDER 1986). A second Indian species, *C. violacea* (Brandt & Ratzeburg 1833), is distributed in a nearby region; other Indian

species (*C. kulzeri* Kaszab 1960, *C. indica* Anand 1979, *C. rajahstanica* Saha 1979) are restricted to the West Indian subcontinent.

A definitive species association is impossible for the African larvae. Personal collection (CAB, AVT) of adults of *C. depressicornis*, *C. granulipennis*, *C. maculifrons* (Mäklin 1875) at light, together with triungulins of *Gd6* (on carabids) and *C.*



Figs 1-6. — *Cyaneolytta* "Gd2", SEM photographs: Fig. 1, habitus, ventral view; Fig. 2, head, ventral view; Fig. 3, head, lateral view; Fig. 4, left antenna; Fig. 5, right maxilla; Fig. 6, mesotibial claw, dorsal view. Scale bars: Fig. 1 = 500 μ m; Figs 2-3 = 200 μ m; Figs 4-6 = 50 μ m.

Table 1.

Morphological differences among the *Cyaneolytta* larvae of the *depressicornis* group (*Gd*).

Character	Taxon							
	<i>depressicornis</i>	<i>Gd1</i>	<i>Gd2</i>	<i>Gd3</i>	<i>Gd4</i>	<i>Gd5</i>	<i>Gd6</i>	<i>Gd7</i>
Body length (mm)	2-2.12	2.06	2.64-2.90	2.80	1.9	1.62	2.62	3.24-3.46
Head size (length/width)	1.35	1.15	1.10-1.19	1.19	1.15	1.12	1.20	1.22
Basal part of frontal sclerite size (length/width)	1.38	1.25	1.33-1.42	1.25	1.00	1.32	1.28	1.41
Setae of fronto- clypeal row (FCR)	long	short	long	long	short	short	long	long
Gular setae	long	short	long	long	short	short	long	long, thin
Prothorax size (length/width at base)	0.79	0.71	0.68-0.76	0.72	0.87	0.69	0.72	0.75
Pattern of setae on posterior margin of abdominal tergites	8	6+2 medial pits	8	6+2 medial pits	6+2 medial pits	8	6+2 short medial setae	8

depressicornis (obtained from oviposition), were made in Somalia (Afgoye). This association suggests that *Gd6* belongs to *C. granulipennis* or *C. maculifrons*, both widely distributed in Africa. Adults of *C. granulipennis*, *C. maculifrons* and *C. resplendens* (Laporte de Castelnau 1840) were sampled (MAB) at light in northern Namibia (Ruacana), together with triangulins of *Gd7* collected on carabids. *Gd7* triangulins were also collected in southern Namibia (Rehobot) where only *C. resplendens* is recorded. Consequently, we suggest that *Gd7* could be *C. resplendens*, a species not collected in Afgoye (Somalia).

Eggs of *Cyaneolytta fryi* are briefly described by SELANDER (1987); those of *C. coerulea* are cited by DHALIWAL et al. (1974), and eggs and triangulins of *C. indica* are cited by ANAND (1980). A micrograph of *C. granulipennis* is reported in Fig. 11.

(a) *depressicornis* group (*Gd*)

This group includes *C. depressicornis* (BOLOGNA et al. 1990) and at least seven other undetermined species, named morpho-species *Gd1-7*. Species *Gd6* and *Gd7* correspond to species A and B described by BOLOGNA et al. (1990).

Distinctive characters include: anterior margin of head strongly rounded, maximum width of head at level of antennae; antennal sensorium as long as 1/2 of article III; basal inner apodemes of head evident and well sclerotised.

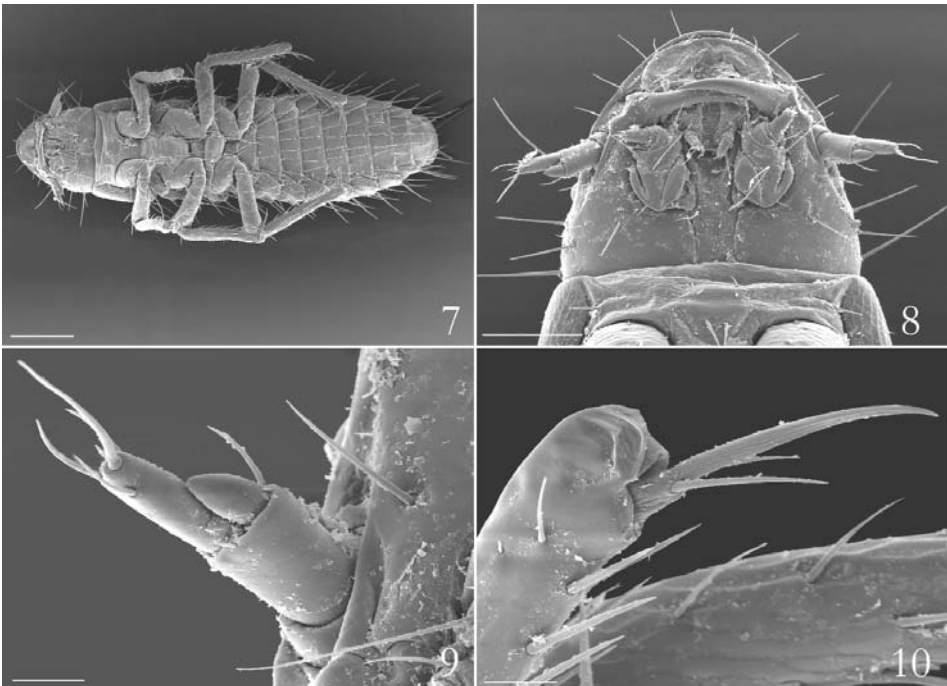
The species of this group have the following characters in common with the *coerulea* and "Sahelian" groups: labrum fused with fronto-clypeal region; setae on

frons of head not modified; ocular setae not anterior to eye; basal setae of head more or less elongate; frontal setae along the frontal suture very short or reduced to pits; eyes laterally positioned; line of dehiscence usually limited to the pro- and mesonotum, or rarely also to the metanotum. The following characters are in common only with the *coerulea* group: antennal segment II subequal in length to I, much shorter than III. The following characters are in common only with the "Sahelian" group: slender labial and maxillary palpi, frontal arms extended almost to the external margin, pronotum subcampaniform and micropunctate on the anterior third, tibiae straight, claws thick and conico-falcate.

The main differences among the nine recognised morpho-species are summarised in Table 1; some features of *Gd1* are represented in Figs 1-6 and differences concerning the head shape in Figs 17-19.

(b) *coerulea* group (*Gc*)

This group includes the triungulin referable to *C. coerulea* (see below), as well as that referred by BOLOGNA et al. (1990) to "Meloini indet." (see BOLOGNA & PINTO 2001) (*Gc5*), and at least another four undetermined species, named morpho-species *Gc1-4*.



Figs 7-10. — *Cyaneolytta* "Gc1", SEM photographs: Fig. 7, habitus, ventral view; Fig. 8, head, ventral view; Fig. 9, left antenna; Fig. 10, mesotibial apex and claw. Scale bars: Fig. 7 = 200 μ m; Fig. 8 = 100 μ m; Figs 9-10 = 20 μ m.

Table 2.
Morphological differences among *Cyaneolytta* larvae of the *coerulea* group (*Gc*).

Character	Taxon					
	<i>coerulea</i>	<i>Gc1</i>	<i>Gc2</i>	<i>Gc3</i>	<i>Gc4</i>	<i>Gc5</i>
Body length (mm)	1.74	1.66	1.16	1.44	1.74	1.22
Head size (length/width)	1.08	1.00	1.24	1.03	1.13	1.28
Stemmata	large	small	small	large	large	large
Seta anterior to stemmata	long	very short	very short	long	long	long
Medial frontal setae	very short	long	long	short	very short	very long
Anterior arms of frontal suture	elongate and angulate	elongate and angulate	elongate and angulate	short and not angulate	elongate and angulate	scarcely elongate and angulate
Basal trasverse ridge	distinct	slightly visible	slightly visible	slightly visible	distinct	distinct
Ventromedial setae of parietalia	long	long	long	short	long	long
Metatibial spines	thick	thin	thin	thin	thick	thick
Claws	distinctly sinuate	slightly sinuate	slightly sinuate	slightly sinuate	slightly sinuate	slightly sinuate

Distinctive characters include: maximal head width at base (posterior third) (this condition is similar to that of the “Sahelian” group, which has the base of the head not so enlarged); basal inner apodemes of head not visible; maxillary and labial palpi short; pronotum subtransverse; fore part of pronotum not micropunctate; tibiae sinuate; claws slender and sinuate.

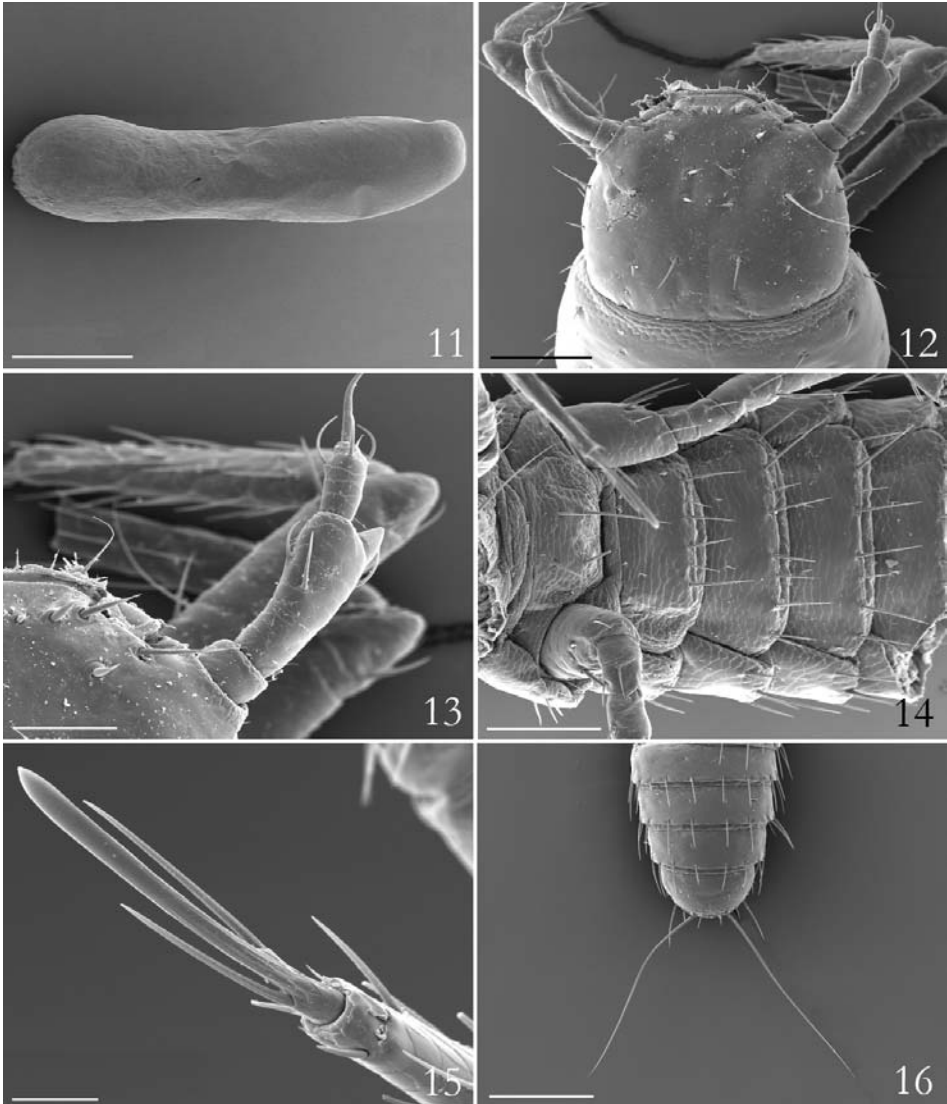
Species of this group are characterised by the combination of the following characters (some of which in common with the *depressicornis* group): labrum fused with fronto-clypeal region; antennal segment II subequal in length to I, much shorter than III; setae on frons of head not modified; ocular setae posterior to eye or middle in position; basal setae of head more or less elongate; setae along the head suture very short or reduced to pits; eyes lateral in position; line of dehiscence usually limited to the pro- and mesonotum, or rarely also to the metanotum. Some of the previous characters are in common with the “Sahelian” group (see below). In common with the “Sahelian” and *fryi* groups are the frontal arms not extended to the external head margin. In common with the *fryi* group only is the length of the antennal sensorium, less than half of segment III.

Differences among the six morpho-species are summarised in Table 2; some features of *Gc1* are represented in Figs 7-10, while the habitus of *C. coerulea* and differences concerning the head shape are represented in Figs 22-28.

(c) "Sahelian" group (*Gs*)

This group, which seems to be very close to the *depressicornis* group (sharing several characters), includes only one species (*Gs1*).

Distinctive characters include: head not enlarged in the fore part, with the maximal width at level of genae but not so enlarged as in the *coerulea* group; basal ridge of head not greatly evident; antennal segment II slightly longer than III and much longer than I; antennal sensorium as long as $2/3$ of segment III.

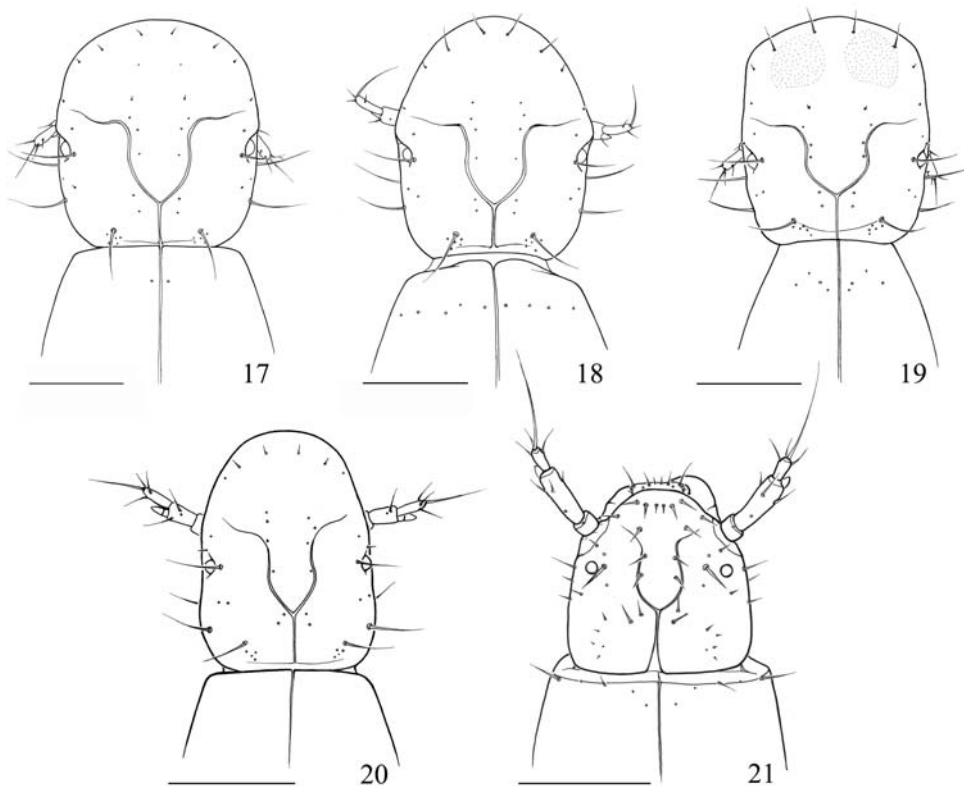


Figs 11-16. — SEM photographs: Fig. 11, *Cyaneolytta granulipennis*, egg; Fig. 12, *C. fryi*, head, dorsal view; Fig. 13, left antenna; Fig. 14, sternites of metathorax and abdominal segments I-III; Fig. 15, mesotibial claw; Fig. 16, last abdominal segments and caudal setae, dorsal view. Scale bars: Fig. 11 = 500 μ m; Figs 12, 14 = 100 μ m; Fig. 13 = 50 μ m; Fig. 15 = 20 μ m; Fig. 16 = 200 μ m.

This species has the following characters in common with the *depressicornis* and *coerulea* groups: labrum fused with fronto-clypeal region; setae on frons of head not modified; ocular setae not anterior to eye; basal setae of head more or less elongate; frontal setae along the frontal suture very short or reduced to pits; eyes lateral in position; line of dehiscence usually limited to the pro- and mesonotum, or rarely also to the metanotum. The following characters are in common only with the *depressicornis* group: slender labial and maxillary palpi, pronotum subcampaniform and micropunctate on the anterior third, tibiae straight, claws thick and conico-falcate. In common with the *coerulea* group are the absence of basal head apodemes and the frontal arms extended almost to the external margin. In common with the *fryi* group are the strongly robust shape of mandibles and the elongate antennal segment II.

The single species of the group (*Gs1*) is characterised by the following features: body total length 1.8 mm; ratio of head length/width: 1.3; medial frontal setae short; ratio (length/width) of the basal part of frontal sclerite: 1.74; setae of fronto-clypeal row (FCR) short; ventromedial setae of parietalia long and thin; gular setae very long and thin; ratio of prothorax length/width at base: 0.582; pattern of setae on posterior margin of abdominal tergites 6 long + 2 medial short.

The head shape is represented in Fig. 20.



Figs 17-21. — Head, dorsal view of: Fig. 17, *Cyaneolytta* “*Gd1*”; Fig. 18, *Cyaneolytta* “*Gd4*”; Fig. 19, *Cyaneolytta* “*Gd5*”; Fig. 20, *Cyaneolytta* “*Gs1*”; Fig. 21, *Cyaneolytta* *fryi*. Scale bars = 0.2 mm.

(d) *fryi* group (*Gf*)

Only *C. fryi* is currently referable to this group; it was described in detail and illustrated by SELANDER (1987).

Species of this group are characterised by the combination of the following characters: mandibles short and strongly curved (sickle-shaped), with wide base and large apodemes; labrum free; antennae elongate, segment II nearly 4 times as long as I, 2 times as long as III; antennal sensorium less than half the length of segment III; frontal setae greatly thickened, strongly tapered, spine-like; eyes dorsally positioned; ocular seta at level of anterior eye margin; basal setae of head very short; gular region membranous, without basal apodemes; pronotum transverse; line of dehiscence partially developed on metanotum.

Some features of *C. fryi* are represented in Figs 12-16 and details of the head in Fig. 21.

KEY TO THE *CYANEOLYTTA* LARVAL MORPHOTYPES

- | | | |
|---|---|---|
| 1 | Labrum free, frontal setae thickened, spine-like; mandibles short and strongly curved; antennal segment II nearly 4 times as long as I; eyes dorsal in position.
..... <i>fryi</i> group | |
| — | Labrum fused with fronto-clypeal region, frontal setae not modified; mandibles elongate and not strongly curved; antennal segment II less than 4 times as long as I; eyes lateral in position | 2 |
| 2 | Basal inner apodemes of head not visible; maxillary and labial palpi short; tibiae sinuate, claws slender and sinuate..... <i>coerulea</i> group | |
| — | Basal inner apodemes of head evident and well sclerotised; maxillary and labial palpi slender; tibiae straight, claws conico-falcate..... | 3 |
| 3 | Head maximal width at level of antennae; antennal segment II subequal to I, antennal sensorium as long as 1/2 of article III | |
| — | Head maximal width at level of genae; antennal segment II distinctly longer than I, sensorium as long as 2/3 of article III | |

REMARKS ON THE *CYANEOLYTTA* LARVAL BIOLOGY

The many new records definitively confirm the phoretic association of triungulins of *Cyaneolytta* with Anthiini. Records of the genera *Tefflus* Leach 1819 and *Psecadius* on Panagaeini (BOLOGNA et al. 1990; Appendix 1 and 2) are uncertain or appear to be exceptional. Also the single record of the genus *Dromica* Dejean 1826 on a Cicindelinae (see Appendix 1 and 2) seems to be occasional, or possibly related to the mimicry between *Dromica* and the anthiine genus *Cypholoba* (a regular vector of *Cyaneolytta* larvae) described by MARSHALL & POULTON (1902) (see also CASSOLA & VIGNA TAGLIANTI 1990, CASSOLA 2002). Thirty-one species of carabids are recognised as vectors, 26 of which are cited for the first time in this paper (Appendix 2).

Cyaneolytta has a fragmented distribution, which includes a subsaharan African subrange, extending to Yemen, and an Indian subrange. The phoretic association with Anthiini occurs in both subranges. For subsaharan Africa this includes

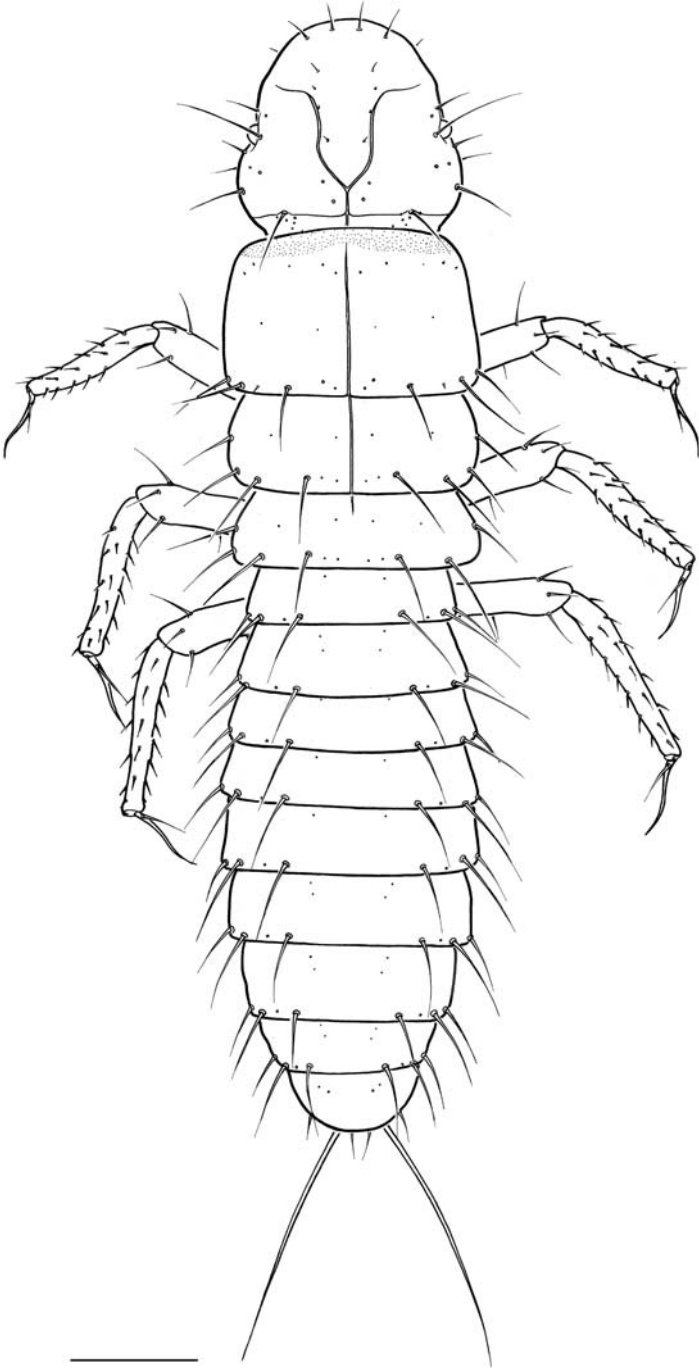


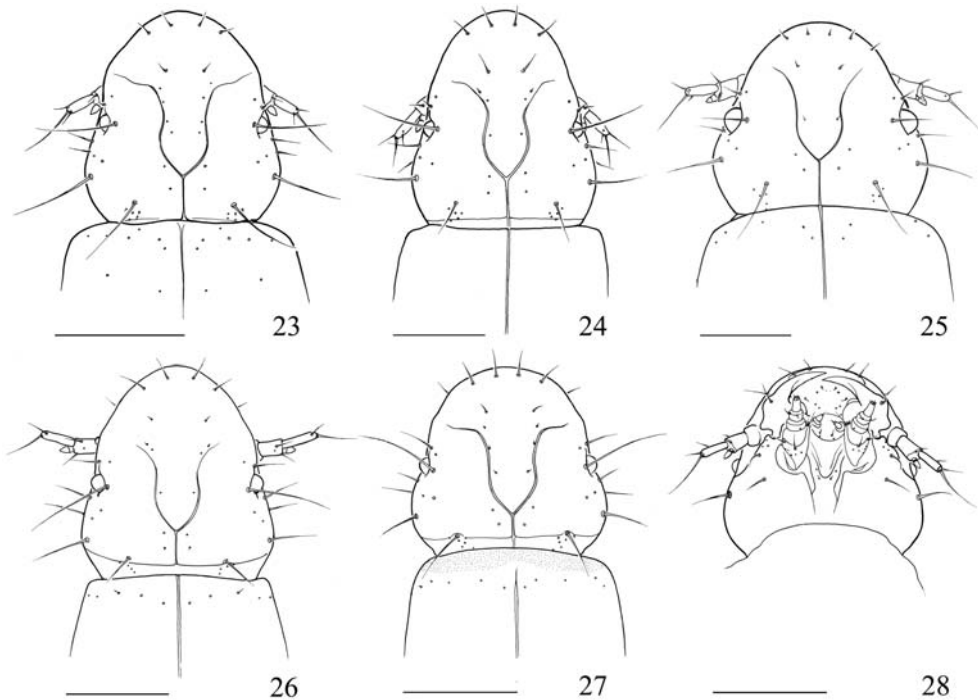
Fig. 22. — *Cyaneolytta coerulea*, habitus, dorsal view. Scale bar = 0.2 mm.

the Sahel (from Senegal to Ethiopia), East Africa (from Somalia to Zambia and Mozambique), southern Africa (from Zimbabwe and northern South Africa through Botswana to central and northern Namibia), Central Africa (Congo ex Zaire), and the Guinea Gulf (from Cameroon to Benin). For the Indian subrange this association is known only in Orissa state. The presence of this association in both geographic subranges supports the hypothesis of its early evolution; it probably originated when the range of the genus *Cyaneolytta* was continuous and not fragmented by the recent desertification of the Arabian Peninsula.

The biological significance of this phoretic association remains a mystery. None of the new records clearly supports one of the various hypotheses proposed by BOLOGNA et al. (1990), but the presence of phoretic triungulins on *Termophilum galla* (Thomson 1859), a predator of ants both at the larval and adult stage (PAARMANN et al. 1986), could support the hypothesis of passive transport into the ant nest to feed on eggs of these insects. The absence of *fryi* specimens from the material collected on carabids supports the hypothesis of their phoresy on bees, as proposed by SELANDER (1987).

Triungulins are attached to setae of all parts of the carabid body, but the largest concentration of specimens was in the abdominal opening. Records on position are listed in Appendix 1.

In some cases more than one morpho-species were found on the same vector, as reported in Appendix 1.



Figs 23-28. — Head, dorsal view of: Fig. 23, *Cyaneolytta* "Gc1"; Fig. 24, *Cyaneolytta* "Gc2"; Fig. 25, *Cyaneolytta* "Gc3"; Fig. 26, *Cyaneolytta* "Gc4"; Fig. 27, *Cyaneolytta* *coerulea*; Fig. 28, *Cyaneolytta* *coerulea*, ventral view. Scale bars: Figs 23, 26-28 = 0.2 mm; Figs 24-25 = 0.1 mm.

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APPENDIX 1

List of new records and other previously studied specimens.

(1) New records

New records are divided into the recognised morpho-species and listed geographically from North to South and from West to East, with the complete indication of host labels (separated by “;”), and the acronyms of the collection where both larvae and carabids are preserved. The current name of the country was added in []. The updated nomenclature of vectors is reported in Appendix 2.

a. *depressicornis* group (*Gd*)*Cyaneolytta depressicornis* (Laporte de Castelnau 1840)

- 1 larva (CAB: slide M294): Ethiopia, Gemu Gofa, Arba Minch, N of Omo River, IV-V.1992, Werner leg., on left posterior femur of *Cypholoba tenuicollis tenuicollis* (Chaudoir 1878) female (AVT).
- 9 larvae (CAB: slide M295, vial P315): Kenya, Malindi, Arabuko Sokoke Forest, 28.IV.1995, F. Cassola leg., on *Cypholoba chanleri* (Linell 1859) male (AVT).
- 1 larva (CAB: slide M390): Zimbabwe, Musengwesi (Rhodesia S), 16.I.1974, Duke leg., on *Dromica pilosifrons* W. Horn 1924 female (TM).
- 22 larvae (CAB: 20 larvae in vial P471 and 2 on slide M394): South Africa, Northern Province, Thabazimbi, 6.XII.2002, P. Schüle leg., on *Cypholoba alveolata alveolata* (Brême 1841) male 3 spread, 3 right antenna, 11 left antenna, 1 left eye, 1 left gena, 2 left protarsus, 1 right elytral omerus (AVT).
- 1 larva (CAB: slide M387): Namibia, Outjo, m 1200, road Outjo-Kalkfeld, 16-20 km S Outjo, 20°14'S – 16°09'E, 28.II.1997, P. Audisio leg., in a collecting tube with *Cypholoba gracilis seineri* Strohmeier 1928 male (AVT).

Gd1

- 7 larvae (MNHN): [Benin] “Dahomey, Ouideu, ex Mus. Sternberg 1910; sur *Thermophilum galla* Thomson, ssp. *georgi* Ancey, female; 47” (MNHN).
- 1 larva (MNHN): [Benin] “Dahomey, Wydah, J.M. Renou 1898; sur *Thermophilum galla* Thomson, ssp. *georgi* Ancey, female; 48” (MNHN).

Gd2

- 1 larva (MNHN): “Cameroun, Ph. Bruneau de Miré leg., Collection Cirad; sur *Thermophilum galla* Thomson *lesnei* Sternb., female, 23.VI.1974, Vina Djivorke; F” (MNHN).
- 1 larva (MNHN): “Cameroun, Ph. Bruneau de Miré leg., Collection Cirad; sur *Anthia lunae*, female, Buffle noir, 23.VI.1974; G” (MNHN).

- 1 larva (MNHN): "Cameroun, Ph. Bruneau de Miré leg., Collection Cirad; sur *Anthia lunae*, male, Buffle noir, 17.VI.1974; H" (MNHN).
- 1 larva (MNHN): "Cameroun, Ph. Bruneau de Miré leg., Collection Cirad; sur *Anthia lunae*, Thomson, male, Bidzar: 3.VII.1972; J" (MNHN).
- 1 larva (MNHN): "Cameroun, Ph. Bruneau de Miré leg., Collection Cirad; sur *Anthia lunae*, Thomson, female, Bidzar: 3.VII.1972; K" (MNHN).
- 1 larva (MNHN): "Cameroun, Ph. Bruneau de Miré leg., Collection Cirad; sur *Anthia lunae*, Thomson, female, Mazam: 28.VI.1974; O" (MNHN).
- 2 larvae (MNHN): "Cameroun, Ph. Bruneau de Miré leg., Collection Cirad; sur *Anthia lunae*, Thomson, female, Mazam: 28.VI.1974; P" (MNHN).
- 3 larvae (MNHN): "Cameroun, Ph. Bruneau de Miré leg., Collection Cirad; sur *Anthia lunae*, Thomson, male, Mazam: 28.VI.1974; Q" (MNHN).
- 1 larva (MNHN): [Chad] "Fort-Sibut, Oubanghi-Chari, Coll. E. Le Moul't; sur *Thermophilum galla* Thomson *congoanum* Basilewski, male; 60" (MNHN).
- 2 larvae (MNHN): [Chad] "Kanem et zone N., Asséchée du Tchad, Mao a Nguigmi, IX-X.1970; Mission Tilmo Dr. R. Gaillard, sur *Anthia lunae* Thomson, male" (MNHN).
- 1 larva (MNHN): [Chad] "Oubanghi-Chari, Fort-Sibut, Museum Paris, Coll. Ch. Alluaud; sur *Anthia lunae* Thomson, male; 1" (MNHN).
- 1 larva (MNHN): [Central African Republic] "Congo Français, Fort-Crampel, Coll. E. Le Moul't; sur *Thermophilum galla* Thomson, ssp. *congoanum* Basilewski, male; 49" (MNHN).
- 2 larvae (MNHN): [probably Ethiopia] "Ex Musaeo Mniszech, sur *Anthia lefebvrei* Guérin, female; 6" (MNHN).
- 1 larva (MNHN): [Ethiopia] "Museum Paris, Coll. C. Alluaud, Abyssinie; sur *Anthia lefebvrei* Guérin, female; 7" (MNHN).
- 1 larva (MNHN): [Ethiopia] "Museum Paris, 1935, Coll. M. Sedillot, Abissinie, Raffray; sur *Anthia lefebvrei* Guérin, female; 8" (MNHN).
- 1 larva (MNHN): [Ethiopia] "Museum Paris, 1932, Mission M. Griaule, Abissinie; sur *Anthia lefebvrei* Guérin, male; 10" (MNHN).
- 1 larva (MNHN): [Somalia] "Museum Paris, Coll. C. Alluaud, Jubaland, H. Clifford; sur *Anthia lefebvrei* Guérin, female; 44" (MNHN).
- 1 larva (MNHN): [Uganda] "Museum Paris, 1933, E. Blanc, Ouganda, Haut Karaguay; sur *Anthia artemis* Gerst., female; 13" (MNHN).
- 1 larva (MNHN): [Kenya] "Museum Paris, Coll. C. Alluaud, Afr. Or. Allim (?); sur *Anthia bucolica* Kolbe, female; 17" (MNHN) (in association with Gc2).
- 1 larva (MNHN): [Kenya] "Museum Paris, ex Coll. M. Maindron, Coll G. Babault, 1930, C. Alluaud; Afrique Orientale Anglaise Taveta, 01.IV.1904; sur *Anthia cavernosa* Gerst., male; 41" (MNHN).
- 1 larva (MNHN): [Kenya] "Mombasa (B.E.A.), G.B., I.1913; sur *Chilanthia cavernosa* Gerst., male; 42" (MNHN).
- 1 larva (MNHN): [Kenya] "Mombasa (B.E.A.), G.B., I.1913; sur *Chilanthia cavernosa* Gerst., male; 43" (MNHN).
- 1 larva (MNHN): [Kenya] "Afrique Orientale Anglaise, Taveta, C. Alluaud, 01.IV.1904; sur *Chilanthia cavernosa* Gerst., female; 45" (MNHN).
- 2 larvae (MNHN): [Kenya] "Afrique Orientale Anglaise, Mombasa, C. Alluaud, (190?); sur *Thermophilumh exasticum* Gerst., female; 46" (MNHN).
- 1 larva (MNHN): [Tanzania?] "Museum Paris, 1932, Coll. E. Le Moul't, Krebreze (?); sur *Anthia bucolica* Kolbe, male; 15" (MNHN).
- 2 larvae (MNHN): [Tanzania] "J. N. Ertl Ukerewe; sur *Anthia bucolica* Kolbe, male; 18" (MNHN).
- 2 larvae (MNHN): [Tanzania] "Museum Paris, 1932, Coll. E. Le Moul't, Marienbe, B. Bukoba; sur *Anthia bucolica* Kolbe, female; 16" (MNHN).
- 1 larva (MNHN): [Tanzania] "Museum Paris, 1886, Revoil, Zanguebar, Tabora; sur *Anthia artemis* Gerst., male; 14" (MNHN).
- 10 larvae (MNHN): [Tanzania] "Africa Or., Lukuledi, Museum Paris, Coll. C. Alluaud, ex Coll.

- F. Schneider; sur *Anthia thoracica* F., ssp. *luculediensis* Stern. male; 30" (MNHN) (in association with *Gd6* and *Gc1*).
- 7 larvae (MNHN): [Tanzania] "Museum Paris, Coll. Sicard, 1930, Dar es Salam; sur *Anthia circumscripta* Klug, male; 35" (MNHN).
- 3 larvae (MNHN): [Tanzania] "D. Ostafrika, Museum Paris, 1932, Coll. E. Le Moul; 2 larvae sous apex élytres, sur *Thermophilum homoplatum* Leq. *parvum* Obst., male; 83" (MNHN) (in association with *Gc1*).
- 2 larvae (MNHN): [Tanzania] "D. Ostafrika, ex Musaeo Car. Sternberg; sur *Thermophilum homoplatum* Leq. *parvum* Obst., male; 84" (MNHN).
- 1 larva (MNHN): [Malawi] "Nyassaland, R.P. Guillet; sur *Anthia bucolica* Kolbe, female; 19" (MNHN).
- 1 larva (CAB: slide M378): [D.R. Congo] Katanga, Ula XI.1976, on left posterior femur of *Anthia circumscripta* Klug 1853 (det. P. Basilewsky 1979) (AC).
- 1 larva (CAB: slide M379): Zambia, Lusaka, Kafue River, Kafue city, m 1800, XII.1988 ex Ferrero; between prosternum and procoxa of *Thermophilum omoplatum* (Lequien 1832) (AC).
- 2 larvae (MNHN): [Zambia] "N. Rhodesia Bodongi Sternb., Museum Paris, Coll. Ch. Alluaud; 38 larvae dans la fente ano-génitale de *Anthia thoracica* F., female; 26" (MNHN) (in association with *Gc1* and *Gc2*).
- 2 larvae (MNHN): "Mozambique, Rikatla, H.A. Junod; sur *Anthia thoracica* F., male; 20" (MNHN).
- 1 larva (MNHN): "Mozambique, Rikatla, H.A. Junod; sur *Anthia thoracica* F., female; 22" (MNHN).
- 2 larvae (MNHN): "Mozambique, Rikatla, H.A. Junod; sur *Anthia cintipennis* Lequien, male; 32" (MNHN).
- 2 larvae (MNHN): "Mozambique, Rikatla, H.A. Junod; sur *Thermophilum fornasinii* Bertol., *unicolor* Chd., male; 80" (MNHN).
- 7 larvae (MNHN): [Mozambique] "Museum Paris, Zambèze, env. de Chemba, Inhacoro, J. Surcouf, XII.1929; sur *Anthia cintipennis* Lequien, male; 33" (MNHN) (in association with *Gc1*).
- 1 larva (MNHN): [Mozambique] "Museum Paris, Zambèze, Chemba, J. Surcouf, XI.1928; sur *Anthia circumscripta* Klug, male; 37" (MNHN).
- 2 larvae (MNHN): [Mozambique] "Museum Paris, Zambèze, env. de Chemba, Inhacoro, J. Surcouf, I.1929; sur *Anthia circumscripta* Klug, male; 39" (MNHN).
- 2 larvae (MNHN): [Mozambique] "Museum Paris, Zambèze, Chemba, XII.1929, J. Surcouf; sur *Thermophilum burchelli* Hope, ssp. *petersi* Klug., male; 68" (MNHN).
- 8 larvae (MNHN): [Mozambique] "Museum Paris, Zambèze, Nova Choupanga, près Chemba, I.1929, J. Surcouf; sur *Thermophilum burchelli* Hope, ssp. *petersi* Klug., male; 69" (MNHN) (in association with *Gc1*).
- 2 larvae (MNHN): [Mozambique?] "Ex Museo H.W. Bates, 1892, Zambesi; sur *Anthia thoracica* F., male; 21" (MNHN).
- 1 larva (MNHN): [Botswana] "Chobe-Land, Nouteiro (?); sur *Thermophilum burchelli* Hope, female; 65" (MNHN).
- 5 larvae: [Botswana] "Chobe-Land, Nouteiro (?); sur *Thermophilum burchelli* Hope, female; 67" (MNHN).
- 1 larva (CAB: slide M385): South Africa, Northern Province, Abal, Erasmus Pass, 16.XII.1995, M. Zapparoli leg. on *Anthia thoracica* (Thunberg 1784) female (AVT).
- 1 larva (MNHN): [South Africa] "Museum Paris, 1932, Coll E. Le Moul, Lydenburg, Transvaal; sur *Anthia maxillosa* F., female; 40" (MNHN).
- 1 larva (MNHN): [South Africa] Shilouvane, près de Leydsdorp, H.A. Junod; sur *Thermophilum burchelli* Hope, male; 66 (MNHN).
- 1 larva (MNHN): [South Africa] "Shilouvane, près Leydsdorp, H.A. Junod; sur *Thermophilum homoplatum* Leq. *mellyi* Brème, female; 82" (MNHN).
- 9 larvae (CAB: 6 in vial P332 and 3 on slide M383): [South Africa] "Transvaal, Kapama Holgspmit, XII.1994, C. Giacoma & E. Balletto leg., on the mesosternum of *Anthia thoracica* (Thunberg 1784), male" (AC).

- 9 larvae (CAB: vial P333, and 2 on slide 384, 3 in UCR): [South Africa] Transvaal, Kapama Holgpsmit, XII.1994, C. Giacoma & E. Balletto leg., on *Anthia thoracica* (Thunberg 1784) male 3 on mesosternum, 1 on left side of prothorax, 3 on prosternum, 1 under pronotal sides (AC).
- 22 larvae (CAB: 11 larvae in vial P330, 3 on slide M380, 4 on stub 71; 6 specimens in UCR): South Africa, Transvaal, Kapama Holgpsmit, XII.1994, C. Giacoma & E. Balletto leg.; on *Termophilum fornasinii* (Bertoloni 1845) 1 on scutellum, 1 on left humerus, 3 on external margin of right elytron, 2 on apex of left elytron, 4 on left mesopleura, 1 on thoracic pleurite, 2 on left metapleura, 2 on medial and 6 on external (left and right) abdominal sternites (AC).
- 1 larva (MNHN): [South Africa] "Museum Paris, 1930, Coll. Sicard, Natal; sur *Anthia thoracica* F., male; 27" (MNHN).

Gd3

- 9 larvae (MNHN): "Senegal, Djibelor, 26.VI.1981, piege lumineux, J. Etienne; sur *Anthia nimrod* Fabricius" (MNHN).

Gd4

- 1 larva (MNHN): [Chad] "Museum Paris, Moyen Chari, Fort Archambault, Boungoul, Ba-Karé; Mission, Chari-Tchad, Dr. J. Decorse, V. 1904; sur *Thermophilum sulcatum* F. ssp. *adelpha* Thoms., var. *simplex* Obst., female; 70" (MNHN).
- 1 larva (MNHN): [Chad] "Museum Paris, Moyen Chari, Fort Archambault, Boungoul, Ba-Karé; Mission, Chari-Tchad, Dr. J. Decorse, V. 1904; sur *Thermophilum sulcatum* F. ssp. *adelpha* Thoms., var. *simplex* Obst., male; 75" (MNHN).
- 1 larva (MNHN): "Cameroun, Ph. Bruneau de Miré leg., Collection Cirad; sur *Thermophilum adelphum* Thomson, male, Yagoua: VIII.1971; C" (MNHN).
- 2 larvae (MNHN): "Cameroun, Ph. Bruneau de Miré leg., Collection Cirad; sur *Thermophilum adelphum* Thomson, male, Garoua: 25.VI.1974; E" (MNHN).

Gd5

- 5 larvae (MNHN): [Niger?] "Museum Paris, Bassin du Moyen Niger. Taganet Keina. 18.VIII.1909, R. Chudeau; sur *Thermophilum sexmaculatum* F., *marginatum* Latr., male; 90" (MNHN).
- 1 larva (MNHN): "Cameroun, Ph. Bruneau de Miré leg., Collection Cirad; sur *Cypholoba tenuicollis* Ch., male, Yagoua, X.1971; A" (MNHN).
- 2 larvae (MNHN): [Chad] "Moyen-Chari, Fort, Archambault, Boungoul (Ba-Karé); Museum Paris, Dr. J. Decorse, Mission Chari-Tchad (V.1904); sur *Cypholoba tenuicollis* Chd. *crampellina* Str., female; 98" (MNHN).
- 2 larvae (MNHN): [Chad] "Moyen-Chari, Fort Archambault, Boungoul (Ba-Karé); Museum Paris, Dr. J. Decorse, Mission Chari-Tchad (mai.1904); sur *Cypholoba tenuicollis* Chd. *crampellina* Str., female; 99" (MNHN).
- 1 larva (MNHN): [Chad] "Moyen Chari, Fort Archambault, Boungoul, (Ba-Karé); Museum Paris, Dr. J. Decorse, Mission, Chari-Tchad (mai 1904); sur *Cypholoba tenuicollis* Chd. *crampellina* Str., female; 100" (MNHN) (in association with *Gs1*).
- 1 larva (MNHN): [Chad] "Moyen-Chari, Fort Archambault, Boungoul (Ba-Karé); Museum Paris, Dr. J. Decorse, Mission Chari-Tchad (mai.1904); sur *Cypholoba tenuicollis* Chd. *crampellina* Str., male; 101" (MNHN).
- 2 larvae (MNHN): [Chad] "Moyen-Chari, Fort Archambault, Boungoul (Ba-Karé); Museum Paris, Dr. J. Decorse, Mission Chari-Tchad (V.1904); sur *Cypholoba tenuicollis* Chd. *crampellina* Str., male; 102" (MNHN).
- 9 larvae (MNHN): [Chad] "Moyen-Chari, Fort Archambault, Boungoul (Ba-Karé); Museum Paris, Dr. J. Decorse, Mission Chari-Tchad (mai.1904); sur *Cypholoba tenuicollis* Chd. *crampellina* Str., male; 103" (MNHN).
- 2 larvae (MNHN): [Chad] "Moyen-Chari, Fort Archambault, Boungoul (Ba-Karé); Museum Paris, Dr. J. Decorse, Mission Chari-Tchad (mai.1904); sur *Cypholoba tenuicollis* Chd.

- crampellina* Str., male; 104" (MNHN).
- 2 larvae (MNHN): [Chad] "Moyen-Chari, Fort Archambault, Boungoul (Ba-Karé); Museum Paris, Dr. J. Decorse, Mission Chari-Tchad (mai.1904); sur *Cypholoba tenuicollis* Chd. *crampellina* Str., male; 105" (MNHN).
- 1 larva (MNHN): [Ethiopia] "Museum Paris, Coll. C. Alluaud, Abissinie; sur *Anthia lefebvrei* Guérin, female; 9" (MNHN).
- 1 larva (MNHN): [Djibouti] "Somalie Française, Djibouti, Moll Holl, 24.I.1903, Coll. A. Bonhoure; sur *Cypholoba caillaudi* Cast., male; 109" (MNHN).
- 1 larva (MNHN): [Kenya] "Afrique Orientale Anglaise: Port de Seringheti, (de Bura a Taveta); 01.IV.1904, Ch. Alluaud, Museum Paris; sur *Cypholoba tenuicollis* Chadoir, female; 95" (MNHN).
- 1 larva (MNHN): [D.R. Congo] "Centre Afr., Ubemba, 1932, Museum Paris, Coll. E. Le Moul; sur *Cypholoba tenuicollis* Chd. *bemba* Stromm, female; 97" (MNHN).
- 1 larva (MNHN): [Tanzania] "Africa Or., Lukuledi, Museum Paris, Coll. C. Alluaud, ex Coll. F. Schneider; sur *Anthia thoracica* F., ssp. *luculediensis* Stern. male; 30" (MNHN) (in association with *Gd2* and *Gc1*).
- 1 larva (MNHN): "Mozambique, Delagoa-Bay, H. A. Junod, 1908-1909; sur *Cypholoba gracilis laurentiana* Stromm, male; 94" (MNHN).
- 1 larva (MNHN): "Mozambique, Rikatla, H.A. Junod; sur *Cypholoba alveolata* Brème *ranzani* Bert., male; 107" (MNHN).

Gd7

- 1 larva (CAB: slide M386): Kenya, Kilifi dint., Arabuko Sokoka Forest Reserve, 20 km S of Malindi, 21.V-7.VI.1994, L. Bartolozzi, B. Cecchi & A. Sforzi leg. (MF), from a collecting vial without vector information.
- 2 larvae (CAB: vial P331 and slide M382): Tanzania, respectively on the right side of prosternum and on the left side of metasternum of *Anthia artemis* Gerstaecker 1884 (AC).
- 1 larva (CAB: slide M399): Tanzania, Iringa Ruaha, P.A. Dutto legit, on *Anthia lunae martensi* Obst 1901 female (AVT).
- 1 larva (CAB: slide M391): Zambia, Livingstone, 800 m, 30.XI.1987, R. Mourglia leg., on *Anthia circumscripta* Klug 1853 male (AVT).
- 1 larva (CAB: slide M388): Namibia, Rehobot town, at light, 23°19'S – 17°04'E, 23.III.1997, 1430 m, M. Bologna leg., on left tibia of *Anthia cinctipennis actaeon* Erichson 1843 female (AVT).
- 1 larva (CAB: slide M393): Namibia, Ruacana, at light 9 p.m., 27.II.2001, M. Bologna & P. Bombi leg., in a collecting tube with one specimen of *Anthia circumscripta* Klug 1853 (AVT).

b. *coerulea* group (**Gc**)

Cyaneolytta coerulea (Pfaff 1824)

- 7 larvae (MNHN): [India] "sur *Pachymorpha sexguttata* F., female; Balasore, R.P. Gengler; 91", 2 larvae inside the ano-genital chamber (MNHN).
- 2 larvae (MNHN): [India] "sur *Pachymorpha sexguttata* F., male; Maïssour Shimoga, V.1897; 92" (MNHN).
- 9 larvae (MNHN): [India] "sur *Pachymorpha sexguttata* F., male; Maïssour Shimoga, VII.1897; 93" (MNHN).
- 1 larva (CAB, slide M186): "India", on sternum of "*Anthia sexguttata*" (UCR).

Gc1

- 2 larvae (MNHN): [Tanzania] "D. Ostafrika, Museum Paris, 1932, Coll. E. Le Moul; 2 larvae sous apex élytres, sur *Thermophilum homoplatum* Leq. *parvum* Obst., male; 83" (MNHN) (in association with *Gd2*).
- 3 larvae (MNHN): [Tanzania] "Africa Or., Lukuledi, Museum Paris, Coll. C. Alluaud, ex Coll. F. Schneider; sur *Anthia thoracica* F., ssp. *luculediensis* Stern. male; 30" (MNHN) (in association with *Gd2* and *Gs1*).

- 32 larvae (MNHN): [Zambia] "N. Rhodesia Bodongi Sternb., Museum Paris, Coll. Ch. Alluaud; 38 larvae dans la fente ano-génitale de *Anthia thoracica* F., female; 26" (MNHN) (in association with *Gd2* and *Gc2*).
- 1 larva (CAB: slide M377): Zambia, Lusaka, Kafue River, 21.XII.1989 ex Ferrero, on *Termophilum omoplatum omoplatum* (Lequien 1832) (AVT).
- 1 larva (CAB: slide M389): Zambia, Kafue, I.1998, F. Ferrero leg., found in a small package with *Tefflus zebulianus reichardi* Kolbe 1886 (AVT). Doubtful host association.
- 4 larvae (CAB: 2 larvae in vials P439 and P472, 1 on slide M392, M395 and 1 on stub 92): Zambia, Lusaka, Kafue River, I.1988, F. Ferrero leg. on methatorax of *Termophilum burchelli burchelli* (Hope 1832) male (AVT).
- 4 larvae (MNHN): [Mozambique] "Museum Paris, Zambèze, env. de Chemba, Inhacoro, J. Surcouf, XII.1929; sur *Anthia cintipennis* Lequien, male; 33" (MNHN) (in association with *Gd2*).
- 4 larvae (MNHN): [Mozambique] "Museum Paris, Zambèze, Nova Choupanga, près Chemba, J. Surcouf, I.1929; sur *Anthia circumscripta* Klug, male; 34" (MNHN).
- 6 larvae (MNHN): [Mozambique] "Museum Paris, Zambèze, Nova Choupanga, près Chemba, I.1929, J. Surcouf; sur *Termophilum burchelli* Hope, ssp. *petersi* Klug., male; 69" (MNHN) (in association with *Gd2*).
- 2 larvae (MNHN): [Botswana] "Museum Paris, Bechuanaland, Gaberones, Vict. Ellenberger, IX.1915; sur *Anthia cintipennis* Lequien, male; 31" (MNHN).
- 1 larva (CAB: slide M381): South Africa, Transvaal, Kapama Holgpsmit, XII.1994, C. Giacoma & E. Balletto leg., on the left side of pronotum of *Termophilum fornasinii* (Bertoloni 1845) (AC).
- 1 larva (MNHN): [Namibia] "Coll. Sternberg, 1910, D.S. W.Afrika, Okahandja, 1902; sur *Anthia thoracica* F., male; 28" (MNHN).

Gc2

- 3 larvae (MNHN): [Kenya] "Museum Paris, Coll. C. Alluaud, Afr. Or. Allim (?); sur *Anthia bucolica* Kolbe, female; 17" (MNHN) (in association with *Gd2*).
- 1 larva (MNHN): [Kenya] "Brit. E. Africa, Campi.Ya. Daktari, Dr. Ansorge, 9.XI.1896; sur *Anthia artemis* Gerst., male; 11" (MNHN).
- 1 larva (MNHN): [Kenya] "Brit. E. Africa, Kiboko R., Dr. Ansorge, 7.XI.1896; sur *Anthia artemis* Gerst., female; 12" (MNHN).
- 1 larva (MNHN): [Kenya] "Afrique Orientale Anglaise: Port, de Seringhéti., de Bura a Taveta; 01.IV.1904; Ch Alluaud, Museum Paris; sur *Cypholoba tetrastigma* Chaudoir *quadriplagiata* Gerst., female; 110" (MNHN).
- 1 larva (CAB: slide M396): Tanzania, Pwani, Seious R. Rafiji, 300-400 m, III.1996, L. De Flavis leg., on abdominal sternite IV of *Termophilum fornasinii fornasinii* (Bertoloni 1845) female (AVT).
- 5 larvae (MNHN): [Zambia] "N. Rhodesia Bodongi Sternb., Museum Paris, Coll. Ch. Alluaud; 38 larvae dans la fente ano-genitale de *Anthia thoracica* F., female; 26" (MNHN) (in association with *Gc1* and *Gd2*).
- 1 larva (CAB: slide M397): Zambia, Lusaka, Kafue River, I.1999, F. Ferrero legit on *Cypholoba alveolata alveolata* (Brème 1844) male (AVT).
- 1 larva (CAB: slide M398): Zambia, Lusaka, Kafue River, I.1999, F. Ferrero legit on *Cypholoba graphipteroides bembana* Strohmeyer 1928 male (AUT).
- 12 larvae (MNHN): "Mozambique, Rikatla, H.A. Junod; sur *Cypholoba alveolata* Brème *ranzani* Bert., male; 108" (MNHN).

Gc3

- 1 larva (MNHN): [Chad] "Oubanghi-Chari, Fort-Sibut; 1 larva sous apex élytres *Termophilum galla* Thomson, ssp. *congoanum* Basilewski, male; 51" (MNHN) (in association with *Gc4*).
- 2 larvae (MNHN): [Chad] "Oubanghi-Chari, Fort-Sibut, Coll. E. Le Moul; sur *Termophilum galla* Thomson ssp. *congoanum* Basilewski, male; 54" (MNHN).

- 1 larva (MNHN): [Chad] "Oubanghi-Chari, Fort-Sibut, Coll. E. Le Moutt; sur *Thermophilum galla* Thomson ssp. *congoanum* Basilewski, male; 57" (MNHN).
- 1 larva (MNHN): [Chad] "Oubanghi-Chari, Fort-Sibut; *Thermophilum galla* Thomson, *congoanum*, Basilewski, male; 62" (MNHN).
- 1 larva (MNHN): [Chad] "Oubanghi-Chari, Fort-Sibut; *Thermophilum galla* Thomson, *congoanum*, Basilewski, male; 63" (MNHN).
- 3 larvae (MNHN): [Chad] "Oubanghi-Chari, Fort-Sibut; *Thermophilum galla* Thomson, *congoanum*, Basilewski, female; 63 bis" (MNHN).
- 1 larva (MNHN): [Central African Republic] "Congo Français, Fort-Crampel, Coll. E. Le Moutt; sur *Thermophilum galla* Thomson, ssp. *congoanum* Basilewski, male; 50" (MNHN).
- 2 larvae (MNHN): [Central African Republic] "Congo Français, Fort-Crampel, Coll. E. Le Moutt; sur *Thermophilum galla* Thomson, ssp. *congoanum* Basilewski, male; 52" (MNHN).
- 2 larvae (MNHN): [Central African Republic] "Congo Français, Fort-Crampel, Coll. E. Le Moutt; sur *Thermophilum galla* Thomson, ssp. *congoanum* Basilewski, male; 53" (MNHN).
- 2 larvae (MNHN): [Central African Republic] "Congo Français, Fort-Crampel, Coll. E. Le Moutt; sur *Thermophilum galla* Thomson, ssp. *congoanum* Basilewski, male; 55" (MNHN).
- 2 larvae (MNHN): [Central African Republic] "Congo Français, Fort-Crampel, Coll. E. Le Moutt; sur *Thermophilum galla* Thomson, ssp. *congoanum* Basilewski, male; 56" (MNHN).
- 4 larvae (MNHN): [Central African Republic] "Congo Français, Fort-Crampel, Coll. E. Le Moutt; sur *Thermophilum galla* Thomson, ssp. *congoanum* Basilewski, male; 58" (MNHN).
- 3 larvae (MNHN): [Central African Republic] "Congo Français, Fort-Crampel, Coll. E. Le Moutt; sur *Thermophilum galla* Thomson, ssp. *congoanum* Basilewski, male; 59" (MNHN).
- 3 larvae (MNHN): [Central African Republic] "Congo Français, Fort-Crampel, Coll. E. Le Moutt; sur *Thermophilum galla* Thomson, *congoanum* Basilewski, female; 61" (1 on anus) (MNHN).
- 2 larvae (MNHN): [Central African Republic] "Congo Français, Fort-Crampel; *Thermophilum galla* Thomson, *congoanum* Basilewski, male; 64" (MNHN).
- 1 larva (MNHN): [Tanzania] "Museum Paris, Coll. C. Alluaud, Tabora; sur *Thermophilum alternatum* Bates, male; 77" (MNHN).

Gc4

- 1 larva (MNHN): [Chad] "Oubanghi-Chari, Fort-Sibut; sous apex élytres *Thermophilum galla* Thomson, ssp. *congoanum* Basilewski, male; 51" (MNHN) (in association with Gc3).
- 14 larvae (MNHN): [Central African Republic] "Congo Français, Fort Crampel, Museum Paris, Coll. E. Le Moutt, 1932; sur *Anthia lunae* Thomson, male; 2" (MNHN).

c. «Sahelian» group (Gs)

Gs1

- 4 larvae (MNHN): [Senegal] "Sur *Thermophilum venator* F., male, Sénégal: Cayor (1898); 85" (MNHN).
- 2 larvae (MNHN): [Chad] "Museum Paris, Moyen Chari, Est des Niellims, Kome (Kouom); Mission, Chari-Tchad, Dr. J. Decorse, Mai 1904; sur *Anthia lunae*, Thomson, female; 5" (MNHN).
- 1 larva (MNHN): [Chad] "Museum Paris, Moyen Chari, Fort Archambault, Boungoul, Ba-Karé; Mission, Chari-Tchad, Dr. J. Decorse, V.1904; sur *Thermophilum sulcatum* F. ssp. *adelpha* Thoms., var. *simplex* Obst., female; 72" (MNHN).
- 4 larvae (MNHN): [Chad] "Museum Paris, Moyen Chari, Fort Archambault, Boungoul, Ba-Karé; Mission, Chari-Tchad, Dr. J. Decorse, V.1904; sur *Thermophilum sulcatum* F. ssp.

adelpha Thoms., var. *simplex* Obst., female; 74" (MNHN).

2 larvae (MNHN): [Chad] "Museum Paris, Moyen Chari, Fort Archambault, Boungoul, Ba-Karé; Mission, Chari-Tchad, Dr. J. Decorse, V.1904; sur *Termophilum sulcatum* F. ssp. *adelpha* Thoms., var. *simplex* Obst., male; 76" (MNHN).

1 larva (MNHN): [Chad] "Moyen Chari, Fort Archambault, Boungoul, (Ba-Kare); Museum Paris, Dr. J. Decorse, Mission, Chari-Tchad (mai 1904); sur *Cypholoba tenuicollis* Chd. *crampelina* Str., female; 100" (MNHN) (in association with *Gd6*).

(2) Specimens cited in the literature (SELANDER 1987; BOLOGNA et al. 1990) and re-examined

a. *depressicornis* group (*Gd*)

Cyaneolytta depressicornis (Laporte de Castelnau 1840)

2 larvae (CAB): Somalia, Afgoi, 7-8.V.1988, S. Bruschi leg., on *Termophilum hexastictum megaera* (Lucas 1881), *Chilanthia cavernosa* (Gerstaecker 1873), *Cypholoba griseostriata* (Fairmaire 1887), *Cypholoba posticalis* (Fairmaire 1885) (AVT).

3 larvae (CAB): Somalia, Afgoi, 12.V.1988, S. Bruschi & A. Vigna leg., on *Chilanthia cavernosa* (Gerstaecker 1873) and *Cypholoba posticalis* (Fairmaire 1885) (AVT).

Gd6 (cited as *Cyaneolytta* sp. A; see BOLOGNA et al. 1990)

5 larvae (CAB): Zimbabwe, Matopos N.P., 30.XI.1980, R. Nardi leg., on *Anthia thoracica* (Thunberg 1784), female, 2 specimens on the right and left posterior margins of the prothorax; 1 specimen under the left side of the prothorax; 1 specimen on the anterior external margin of the right half of the mesosternum (AVT).

Gd7 (cited as *Cyaneolytta* sp. B; see BOLOGNA et al. 1990)

1 larva (CAB): Somalia, Afgoi, 7-8.V.1988, F. Cassola leg., on *Termophilum hexastictum megaera* (Lucas 1881) male (AVT).

1 larva (CAB): Somalia, Afgoi, 7-8.V.1988, F. Cassola leg., on *Cypholoba griseostriata* (Fairmaire 1884) male (AVT).

1 larva (CAB): Somalia, Afgoi, 8.V.1988, F. Cassola leg., on *Cypholoba posticalis* (Fairmaire 1885) male (AVT).

1 larva (CAB): Somalia, Afgoi, 7-8.V.1988, S. Bruschi leg., *Chilanthia cavernosa* (Gerstaecker 1873) female (AVT).

12 larvae (CAB): Somalia, Afgoi, 7-9.V.1988, S. Bruschi & A. Vigna leg., on *Termophilum hexastictum megaera* (Lucas 1881), *Chilanthia cavernosa* (Gerstaecker 1873), *Cypholoba posticalis* (Fairmaire 1885), *Cypholoba griseostriata* (Fairmaire 1887) (AVT).

1 larva (CAB): Somalia, Afgoi, 10.V.1988, S. Bruschi leg., on *Chilanthia cavernosa* (Gerstaecker 1873) (AVT).

21 larvae (CAB): Somalia, Afgoi, 12.V.1988, S. Bruschi & A. Vigna leg., on *Chilanthia cavernosa* (Gerstaecker 1873) and *Cypholoba posticalis* (Fairmaire 1885) (AVT).

3 larvae (CAB): Somalia, Afgoi, 21.V.1988, S. Bruschi & A. Vigna leg., with *Termophilum hexastictum megaera* (Lucas 1881) and *Cypholoba posticalis* (Fairmaire 1885) (AVT).

1 larva (CAB): Somalia, env. Mogadishu, V.1989, B. Bertolini leg., on *Psecadius eustalactus somalus* (Müller 1941) (AVT).

b. *coerulea* group (*Gc*)

Gc5 (cited as "Meloini indet."; see BOLOGNA et al. 1990)

1 larva (CAB): Zimbabwe, 25.XII.1970, J. Sedlacek leg., on *Termophilum fornasinii* (Bertoloni 1845) male (AVT)

d. *fryi* group (*Gf*)

Cyaneolytta fryi (Wollaston 1861)

5 larvae (3 larvae on slide M293 and 1 in vial P370, 1 in stub 90) (CAB): Senegal, Bombay, 11.VIII.1985, R.B. Selander leg. (see SELANDER 1987).

APPENDIX 2

List of the Carabidae species recorded as vectors of *Cyaneolytta* triungulins.

Carabid host	<i>Cyaneolytta</i> 1st instar larvae	Source
<i>Dromica</i> Dejean 1826		
<i>Dromica pilosifrons</i> W. Horn 1924	<i>C. depressicornis</i>	original
<i>Cypholoba</i> Chaudoir 1850		
<i>Cypholoba alveolata alveolata</i> (Brême 1844)	<i>C. depressicornis</i> , <i>Gc2</i>	original
<i>Cypholoba alveolata ranzanii</i> (Bertoloni 1849)	<i>Gd5</i> ; <i>Gc2</i>	original
<i>Cypholoba caillaudi</i> (Laporte de Castelnau 1835)	<i>Gd5</i>	original
<i>Cypholoba chanleri</i> (Linell 1896)	<i>C. depressicornis</i>	original
<i>Cypholoba gracilis laurentina</i> Strohmeyer 1928	<i>Gd5</i>	original
<i>Cypholoba gracilis seineri</i> Strohmeyer 1928	<i>C. depressicornis</i>	original
<i>Cypholoba graphipteroides bembana</i> Strohmeyer 1928	<i>Gc2</i>	original
<i>Cypholoba griseostriata</i> (Fairmaire 1884) (= <i>posticalis</i> Fairmaire 1885 partim)	<i>C. depressicornis</i> ; <i>Gd7</i>	(BOLOGNA et al. 1990)
<i>Cypholoba tenuicollis tenuicollis</i> (Chaudoir 1878)	<i>C. depressicornis</i> ; <i>Gd5</i>	original
<i>Cypholoba tenuicollis crampelina</i> Strohmeyer 1928 (= " <i>crampellina</i> " auct.)	<i>Gd5</i> ; <i>Gs1</i>	original
<i>Cypholoba tenuicollis errata</i> Strohmeyer 1928 (= <i>bemba</i> Strohmeyer 1928)	<i>Gd5</i>	original
<i>Cypholoba tetrastigma tetrastigma</i> (Chaudoir 1848) (= <i>quadriplagiata</i> Gerstaecker 1866)	<i>Gc2</i>	original
<i>Chilanthia</i> Obst 1901		
<i>Chilanthia cavernosa</i> (Gerstaecker 1866)	<i>C. depressicornis</i> ; <i>Gd2</i> ; <i>Gd7</i>	(BOLOGNA et al. 1990), original
<i>Termophilum</i> Basilewsky 1950 (= " <i>Thermophilum</i> " auct.)		
<i>Termophilum alternatum</i> (Bates 1878)	<i>Gc3</i>	original
<i>Termophilum burchelli burchelli</i> (Hope 1832)	<i>Gd2</i> ; <i>Gc1</i>	original
<i>Termophilum burchelli petersi</i> (Klug 1853)	<i>Gd2</i> ; <i>Gc1</i>	original
<i>Termophilum fornasinii fornasinii</i> (Bertoloni 1845) (= <i>unicolor</i> Chaudoir 1861)	<i>Gd2</i> ; <i>Gc1</i> ; <i>Gc2</i>	original
<i>Termophilum fornasinii fornasinii</i> (Bertoloni 1845)	<i>Gc5</i>	(BOLOGNA et al. 1990)
<i>Termophilum galla galla</i> (J. Thomson 1859) (= <i>georgei</i> Ancey 1886) (= <i>congoanum</i> Basilewsky 1948)	<i>Gd1</i> ; <i>Gd2</i> ; <i>Gc3</i> ; <i>Gc4</i>	original
<i>Termophilum galla lesnei</i> (Sternberg 1906)	<i>Gd2</i>	original
<i>Termophilum hexastictum hexastictum</i> (Gerstaecker 1866)	<i>Gd2</i>	original
<i>Termophilum hexastictum megaera</i> (Lucas 1881)	<i>C. depressicornis</i>	(BOLOGNA et al. 1990)
<i>Termophilum nimrod nimrod</i> (Fabricius 1793)	<i>Gd3</i>	original
<i>Termophilum omoplatum omoplatum</i> (Lequien 1832) (= " <i>homoplatum</i> " auct.) (= <i>mellyi</i> Brême 1844)	<i>Gd2</i> ; <i>Gc1</i>	original
<i>Termophilum omoplatum parvum</i> (Obst 1901)	<i>Gd2</i> ; <i>Gc1</i>	original
<i>Termophilum sexmaculatum marginatum</i> (Latreille 1823)	<i>Gd5</i>	original

<i>Termophilum sulcatum sulcatum</i> (Fabricius 1793) (= <i>adelphum</i> J. Thomson 1859) (= <i>simplex</i> Obst 1901)	<i>Gd4; Gs1</i>	original
<i>Termophilum venator</i> (Fabricius 1793)	<i>Gs1</i>	original
<i>Anthia</i> Weber 1801		
<i>Anthia artemis</i> Gerstaecker 1884	<i>Gd2; Gd7; Gc2</i>	original
<i>Anthia bucolica</i> Kolbe 1894	<i>Gd2; Gc2</i>	original
<i>Anthia cintipennis cintipennis</i> Lequien 1832	<i>Gd2; Gc1</i>	original
<i>Anthia cintipennis actaeon</i> Erichson 1843	<i>Gd7</i>	original
<i>Anthia circumscripta circumscripta</i> Klug 1853	<i>Gd2; Gd7; Gc1</i>	original
<i>Anthia lefebvrei</i> Guérin-Ménéville 1849	<i>Gd2; Gd5</i>	original
<i>Anthia lunae lunae</i> J. Thomson 1859 (= <i>tomentosa</i> Chaudoir 1861)	<i>Gd2; Gc4; Gs1</i>	original
<i>Anthia lunae martensi</i> Obst 1901	<i>Gd7</i>	original
<i>Anthia maxillosa</i> (Fabricius 1793)	<i>Gd2</i>	original
<i>Anthia thoracica thoracica</i> (Thunberg 1784)	<i>Gd2; Gd6; Gc1; Gc2</i>	original
<i>Anthia thoracica lukulediensis</i> Sternberg 1907	<i>Gd2; Gd5; Gc1</i>	original
<i>Pachymorpha</i> Hope 1838		
<i>Pachymorpha sexguttata</i> (Fabricius 1775)	<i>C. coerulea</i>	original
<i>Tefflus</i> Leach 1819		
<i>Tefflus zebulianus reichardi</i> Kolbe 1886	<i>Gc1</i>	original (doubtful association)
<i>Psecadius</i> Alluaud 1911		
<i>Psecadius eustalactus somalus</i> G. Müller 1941	<i>Gd7</i>	(BOLOGNA et al. 1990)