

# Resolving the synonymy of *Paraphanocles keratoskeleton* (Olivier, 1792) (Phasmida: Diapheromerinae)

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## Introduction

*Paraphanocles keratoskeleton* was originally described by Stoll in 1788, although he did not use binominal nomenclature. The first valid publication of a name for this species, *Mantis keratoskeleton*, was published in Olivier 1792. Lichtenstein, presumably unaware of the work of Olivier, described *Phasma cornutum* Lichtenstein 1802 as an objective synonym. Stoll's later work was edited and published posthumously in 1813, with the same species bearing the binominal *Phasma bicornis* Stoll 1813. The objective synonyms resulting from the work of Stoll, Lichtenstein and Olivier are discussed by Bragg 1995.

The genus *Paraphanocles* was erected by Zompro 2001 containing the single species *Mantis keratoskeleton* Olivier 1792. The genus is differentiated from *Phanocles* Stål 1875 in the male by a dilating tergite X that is wider than tergite IX, in females by the lack of lateral lobes on tergite VI. In the same publication Zompro synonymised *Bacteria bellangeri* Redtenbacher 1908, *Bacteria bradypus* Redtenbacher 1908, *Bacteria integra* Redtenbacher 1908 and *Bacteria maxwelli* Redtenbacher 1908 with *Pa. keratoskeleton*. Prior to this Redtenbacher 1908 made *Phanocles curvipes* Redtenbacher, 1892 a junior synonym of *Phasma bicornis* Stoll 1813. *Dyme mutica* Brunner von Wattenwyl, 1907 was subsequently synonymised with *Pa. keratoskeleton* by Bellanger et al. 2012. Otte & Brock 2005 later synonymised *Bacteria cyphus* Westwood, 1859 under *Pa. keratoskeleton*.

Examination of type material of the species currently synonymised under *Pa. keratoskeleton* has revealed errors in prior works. In this paper we demonstrate that *Dyme mutica* and *Bacteria integra* form a distinct species from *Pa. keratoskeleton* and transfer them to the genus *Phanocles* sensu Zompro 2001. This species is believed to be endemic to Trinidad and Tobago. *Bacteria maxwelli* Redtenbacher 1908 has its abdominal segment X as widened as the posterior half of abdominal tergite IX in the male, excluding it from membership of *Paraphanocles* sensu Zompro, 2001 even though it was this author who synonymised the species. We remove *B. maxwelli* from synonymy under *Pa. keratoskeleton* and transfer it to the genus *Bacteria*.



Figure 1. Adult male corresponding to the type of *Dyme mutica* collected by Baker in Tobago, January 2016.

## Materials and methods

A male phasmid, corresponding to the type of *Dyme mutica* collected by Baker in Tobago (Fig. 1), was found by the authors to differ significantly from males from the type series of various species currently synonymised under *Pa. keratoskeleton*. Further research using the Phasmida Species File (Brock et al. 2016) and original type material confirmed that *Dyme mutica* should be considered a valid species in the genus *Phanocles* and that *B. maxwelli* does not belong to the genus *Paraphanocles*. Further investigation of the current nine synonyms of *Paraphanocles keratoskeleton* revealed that *Bacteria maxwelli* and *Bacteria bellangeri* are conspecific with each other, but not with *Pa. keratoskeleton*.

## Specimen Repositories

MNHN	Muséum national d'Histoire naturelle, Paris, France
NHMUK	Natural History Museum, London, United Kingdom
NMW	Naturhistorisches Museum, Vienna, Austria

## Material Examined

HOLOTYPE: *Bacteria cyphus*. BMNH(E):#844538. West Indies. SYNTYPE x3: *Phanocles curvipes*. BMNH(E):#844539,#844540,#844541. St Vincent. HOLOTYPE: *Dyme mutica*. NMW. Trinidad. HOLOTYPE: *Bacteria integra*. NMW, Trinidad. LECTOTYPE, PARALECTOTYPE. *Bacteria maxwelli*. MNHN-EO-PHAS571.

## Taxon Treatments

### *Paraphanocles keratoskeleton* (Olivier, 1792)

- = *Phasma cornutum* Lichtenstein, 1796 (objective synonym)
- = *Phasma bicornis* Stoll, 1813 (objective synonym)
- = *Bacteria bradypus* Redtenbacher, 1908 (junior synonym)

### Diagnosis

Male: Protrusions on the head. Tergite X wider than the posterior of tergite IX. Last tergite strongly curved. Cerci protruding longer than anal segment. Setose.

### *Phanocles mutica* (Brunner von Wattenwyl, 1907) n. comb.

- Dyme mutica* Brunner von Wattenwyl 1907
- = *Bacteria integra* Redtenbacher, 1908 (junior synonym)

*Dyme mutica* is removed from synonymy under *Paraphanocles keratoskeleton* and transferred to the genus *Phanocles*.

### New specimens examined

1 Male; Mary's Hill Lodge, Tobago 14m. 11.20N,60.75W. 2017.i.27. Coll. E. Baker.

### Diagnosis (Figs 2, 3)

Male: lack of protrusions on the head and tergite X of the male being as wide as the posterior of tergite IX. Anal segment straight and flat, narrowing distally.

Female: subgenital plate more than 1.5x the length of the last tergite. Cerci protude past anal segment.

### Distribution

Currently considered to be endemic to the islands of Trinidad and Tobago (Bellanger et al. 2012, Langlois and Bellanger 2012).

### Ecology

A common species of xerophilic environments on the islands. Specimen collected by Baker found in close proximity to Glory Cedar (*Gliricidia sepium*, Fabaceae), on which it also fed on for a few days in



Figure 2A. Holotype of *Dyme mutica* end of abdomen (ventral) NMW



Figure 2B. Holotype of *Dyme mutica* metathorax (lateral) NMW



Figure 2C. Holotype of *Dyme mutica* (specimen labels) NMW



Figure 2D. *Phanocles mutica* end of abdomen.

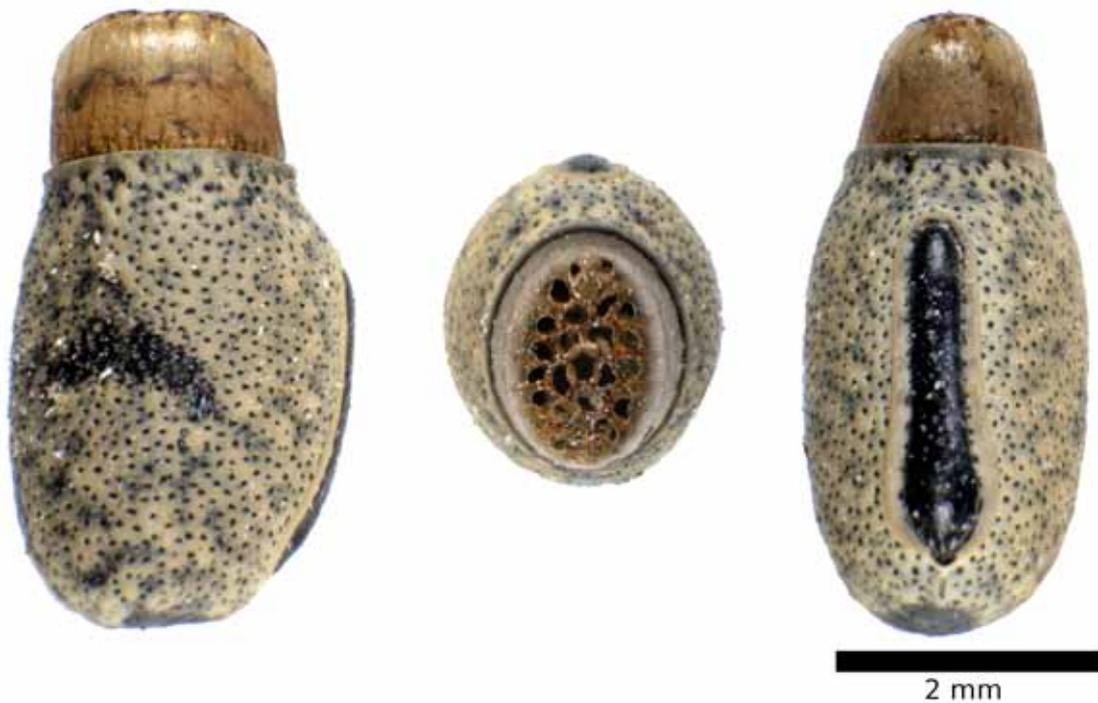


Figure 2E. *Phanocles mutica* eggs descendants of a female from Trinidad (leg. Y. Bellanger).  
F. Tetraert.



Figure 3A. Holotype of *Bacteria integra* abdomen (dorsal)



Figure 3B. Holotype of *Bacteria integra* metathorax (dorsal)



Figure 3C. Holotype of *Bacteria integra* (specimen labels)

captivity. This tree species is introduced to the island. Bellanger et al. (2012) report the species to feed on *Chamaecrista nictitans* (Fabaceae) and a species of *Cecropia* (Urticaceae). It is likely to be highly polyphagous, and in captivity accepts several species from the Rosaceae and Fabaceae (Bellanger et al. 2012, Langlois and Bellanger 2012 ).

#### *Taxon discussion*

*Dyme mutica* and *Bacteria integra* were both described using single specimens of differing sexes from Trinidad and Tobago. The work of Bellanger et al. (2012) and Langlois & Bellanger (2012) found only a single species of the *Phanocles* group sensu Zompro (2001) on the islands. This single species matches the type material of both *Dyme mutica* and *Bacteria integra*, and these two species are considered here to be synonymous. It is supposed by that the habitus of specimens from Trinidad and Tobago examined by Bellanger et al. 2012 and Langlois and Bellanger (2012) differ from the continental american populations of *Pa. keratoskeleton* and might be a different species. As the type specimen of *Pa. keratoskeleton* belongs to a continental population and originated from Suriname, this leads to the assumption that the, morphological different, specimen described as *D. mutica* is not synonym of *Pa. keratoskeleton*, contrary to the synonymisation by Langlois and Bellanger (2012).

#### ***Bacteria maxwelli* (Redtenbacher, 1908) n. comb.**

*Bacteria maxwelli* Redtenbacher, 1908

= *Bacteria bellangeri* Redtenbacher, 1908 (junior synonym)

#### *Diagnosis* (Figs 4-8)

Male: protrusions on the head. Tergite X as wide as the posterior of tergite IX. Cerci protruding past anal segment.

Female: subgenital plate protrudes last tergite more than 1.5x the length of the last tergite. Cerci protruding past anal segment.

#### *Distribution*

Martinique.

#### ***Phanocles curvipes* Redtenbacher, 1892 n. comb.**

*Phanocles curvipes* Redtenbacher, 1892

*Bacteria cyphus* is removed from synonymy under *Paraphanocles keratoskeleton* and transferred to the genus *Phanocles* .

#### *Diagnosis*

Male: protrusions on the head. Anal segment broadened. Long cerci.

Female: protrusions on the head. Subgenital plate protrudes anal segment only shortly. Cerci not reaching over the anal segment.

#### ***Dyme cyphus* (Westwood, 1859) n. comb. Nomenclature**

*Bacteria cyphus* Westwood, 1859

*Bacteria cyphus* is removed from synonymy under *Paraphanocles keratoskeleton* and transferred to the genus *Dyme*.

#### *Diagnosis*

Male: head with protrusions. Cerci short, not exceeding the last tergite. Last tergite broadened distally.

#### *Egg*

As defined for *Dyme*, the ovae of *D. cyphus* lack a capitulum (Sellick 1997, Sellick 1988 ).



Figure 4A. Lectotype of *Bacteria maxwelli*. MNHN.



Figure 4B. Lectotype of *Bacteria maxwelli*. MNHN.



Figure 5A. Paralectotype *Bacteria maxwelli* (NMW)



Figure 5B. Paralectotype *Bacteria maxwelli* (NMW)



Figure 6A. *Bacteria maxwelli* male (NMW)



Figure 6B. *Bacteria maxwelli* male (NMW)

**Identification key to the males of the species hitherto confunded under the name of *Paraphanocles keratosqueleton***

- |   |  |                                      |
|---|--|--------------------------------------|
| 1 | Head with protrusions                            | 2                                    |
|   | Head without protrusions                         | <i>Phanocles mutica</i>              |
| 2 | Cerci long, extending beyond anal segment        | 3                                    |
|   | Cerci short, not extending beyond anal segment   | <i>Dyme cyphus</i>                   |
| 3 | Tergite X as wide as the posterior of tergite IX | 4                                    |
|   | Tergite X wider than the posterior of tergite IX | <i>Paraphanocles keratosqueleton</i> |
| 4 | Last tergite broadened                           | <i>Phanocles curvipes</i>            |
|   | Last tergite not broadened                       | <i>Bacteria maxwelli</i>             |



Figure 7A. *Bacteria maxwelli* female (NMW) abdomen (lateral)



Figure 7B. *Bacteria maxwelli* female (NMW) metathorax (lateral)



Figure 7C. *Bacteria maxwelli* female (NMW) label

## Discussion

### *Biogeography*

While culturally being part of the Caribbean the islands of Trinidad and Tobago, close to the north eastern coast of Venezuela, are on the South American continental plate, and a large proportion of their fauna is South American in origin. The distribution of several notable species, in particular the White-tailed Sabrewing *Campylopterus ensipennis* (Swainson, 1822), reflects this geological history. In contrast the remainder of the Lesser Antilles belong to the Caribbean plate. The fact that *Phanocles mutica* is found on Trinidad and Tobago reflects this history, with *Phanocles* having a mainland Central and South American distribution (Brock et al., 2016).

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## References

Bellanger Y, Jourdan T, Lelong P (2012) Contribution à l'inventaire et à la biologie des Phasmatodea de Trinidad. Bulletin de la Société entomologique de France 117 (4): 483-502. [In French]. URL: [http://www.lasef.org/new/117%284%29/1608\\_Bellanger%20et%20al.pdf](http://www.lasef.org/new/117%284%29/1608_Bellanger%20et%20al.pdf)

Bragg PE (1995) Comments on the species of Phasmida described by Stoll in 1788 and named by Olivier in 1792. Phasmid Studies 4(1): 25-25. <http://phasmid-study-group.org/sites/phasmid-study-group.org/files/Bragg1995c.pdf>

Brock PD, Buscher T & Baker E (2016) Phasmida Species File Online. Version 5.0/5.0 . <http://Phasmida.SpeciesFile.org>. Accessed on: 2016-2-12

Langlois F, Bellanger Y (2012) Inventaire des Phasmatodea de Tobago. Bulletin de la Société entomologique de France 117 (1): 91-110. [In French]. URL: <http://www.asper.org/articles/inventobago.pdf>

Lichtenstein AAH (1802) A Dissertation on two Natural Genera hitherto confounded under the name of Mantis. Transactions of the Linnean Society of London 6 (1): 1-39. <https://doi.org/10.1111/j.1096-3642.1802.tb00466.x>

Olivier (1792) Encyclopédie Méthodique, ou par ordre de matières par un société de gens de lettres, de savans et d'artistes. Histoire Naturelle 7: 1-368. C.H. Agasse, Imprimeur-Libraire, Paris, France.

Redtenbacher J (1908) Redtenbacher, J. (1908): Die Insektenfamilie der Phasmiden. Vol. 3. Phasmidae Anareolatae (Phibalosomini, Acrophyllini, Necrosiini). Wilhelm Engelmann, Leipzig, 248 pp.

Sellick J (1988) The capitula of phasmid eggs: an update with a review of the current state of phasmid ootaxonomy. Zoological Journal of the Linnean Society 93 (3): 273-282. <https://doi.org/10.1111/j.1096-3642.1988.tb01364.x>

Sellick J (1997) The range of egg capsule morphology within the phasmatodea and its relevance to the taxonomy of the order. Italian Journal of Zoology 64 (1): 97-104. <https://doi.org/10.1080/11250009709356178>

Stål C (1875) Recensio orthopterorum. Revue critique des Orthoptères décrits par Linné, DeGeer et Thunberg. 3. Öfversigt af Kongliga Vetenskaps-Akademiens Förhandlingar 3: 1-105.

Stoll C (1813) Natuurlyke en naar 't leeven naauwkeurig gekleurde afbeeldingen en beschryvingen der spooken, wandelende, bladen, zabelspringhaanen, krekels, treksprinkhaanen en kakkerlakken. [Représentation exactement colorée d'après nature des spectres, des mantes, des sauterelles, des grillons, des criquets et des blattes]. Amsterdam, 56 pp.

Zompro O (2001) A generic revision of the insect order Phasmatodea: The New World genera of the stick insect subfamily Diapheromeridae: Diapheromerinae=Heteronemiidae: Heteronemiinae sensu Bradley & Galil, 1977. Revue suisse de zoologie. 108: 189-255. <https://doi.org/10.5962/bhl.part.79626>