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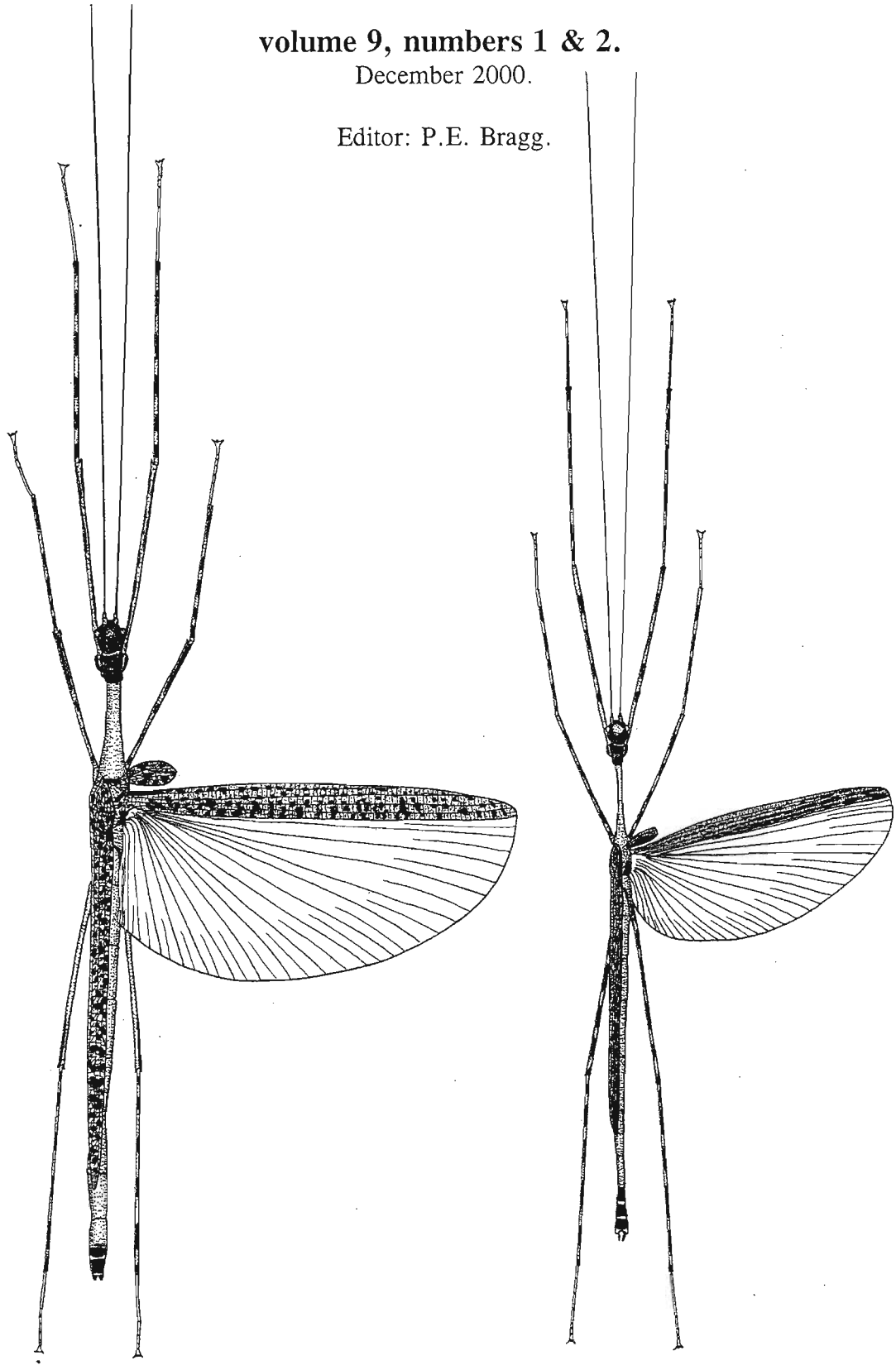

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Contents

Cover illustration: *Orthonecroscia pulcherrima* Kirby, drawing by P.E. Bragg.

Species Report PSG. 122, *Anisomorpha monstrosa* Hebard

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With illustrations by P.E. Bragg.

Abstract
This report summarises the care and breeding of *Anisomorpha monstrosa* Hebard, the largest species in the genus. Behaviour and defence mechanism are also discussed along with descriptions of the eggs, nymphs, and adults.

Key words
Phasmida, *Anisomorpha monstrosa*, Pseudophasmatinae, Rearing, Distribution, Defence.

Taxonomy

Anisomorpha monstrosa belongs to the sub-family Pseudophasmatinae. It was described in 1932 by Hebard (1932: 214) and is the largest species in the genus. The type specimen is a female collected from Merida, in Yucatan, Mexico.

Culture History

The original culture of this species was collected in Belize, approximately 150km north of Belize City by Jan Meerman in 1993 or 1994 (D'Hulster, personal communication). This species has now become widespread within the Phasmid Study Group, especially in Europe. The founder specimens of the captive population were collected under logs and stones in the jungle.

Distribution

Anisomorpha monstrosa is known to occur in Mexico and Belize (Brock, 1999).

Description of Adults (Figures 1 & 2)

Mature specimens of this species have a glossy appearance, both sexes being wingless. The body is essentially black in colour. The bodies of both sexes possess two orange/bronze dorsal stripes, stretching from behind the head to the tip of the abdomen. There is very little variation in the adult colour of this species. Adult females attain 69mm in length ($\bar{x}$ = 66.75mm (SD $\pm$ 2.4mm) n=6), which is smaller that the type specimen (87.6mm). This is not surprising as the founder stock was from only 40 eggs. The reduction in size over the generations probably is the result of inbreeding. The female is a heavily built, robust insect, which can reach a considerable girth at the height of egg production. The male is much smaller, reaching 38mm in length ($\bar{x}$ = 37.8mm (SD $\pm$ 2.58mm) n=5).

Nymphs

Newly hatched nymphs measure 12mm in length ($\bar{x}$ = 12.0 (SD $\pm$ 1.4mm) n=18). When newly hatched the nymphs are brown in colour, taking on the adult appearance at around adulthood, usually one ecdysis preceding maturity. The nymphs, like adults are gregarious.

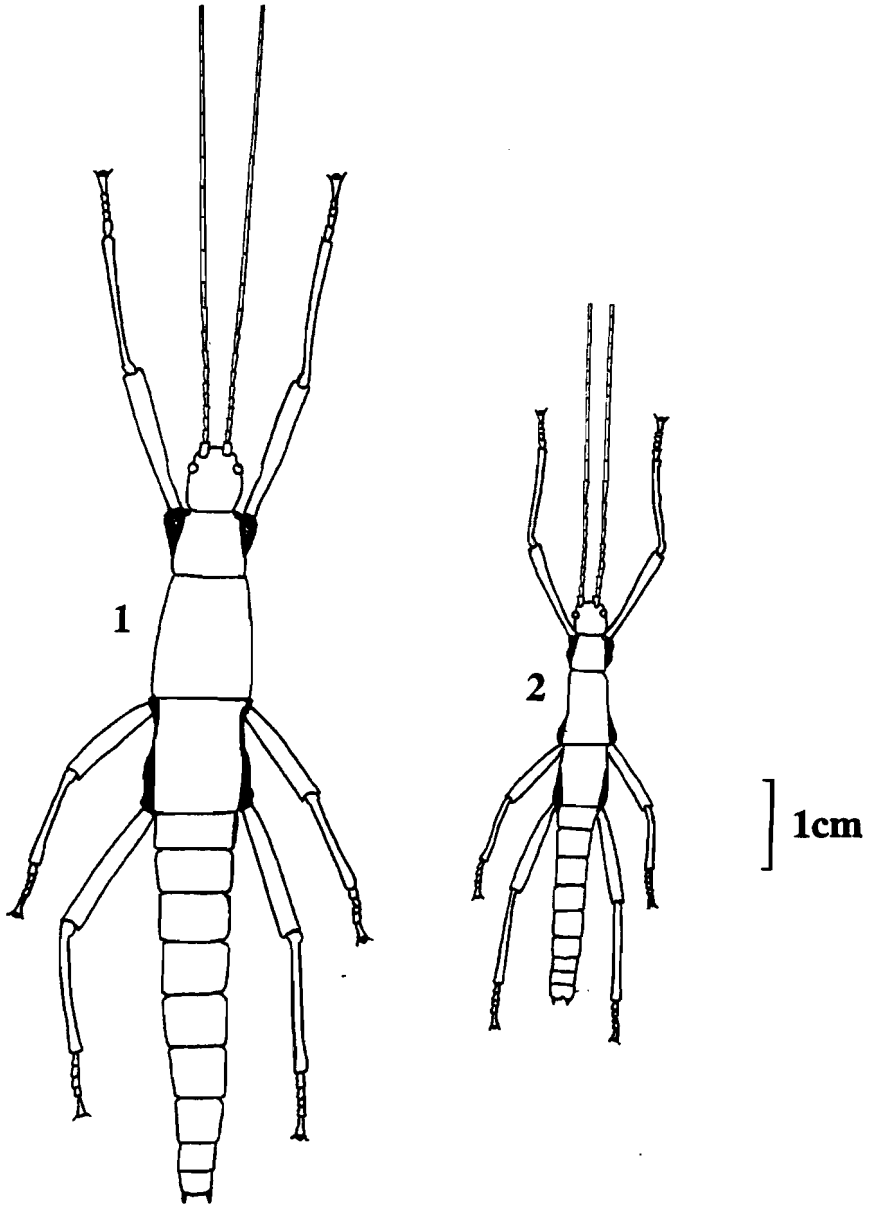
Eggs

The eggs are typical of the genus, being barrel shaped. There is considerable variation in the dimensions of the egg, the mean sizes being height 3mm, length 1.5mm, width 1.5mm (corresponding SD $\pm$ 0.75mm, 0.25mm, 0.25mm; n= 20). The coloration is also variable from fawn through to grey, with the surface of the egg being smooth to granular. The micropylar plate is small as in *A. buprestoides* (see Carlberg & Sellick, 1991). The fertility rate of the eggs is high with a hatch rate greater than 80%. Eggs incubated at room

temperature with 50-70% humidity hatch in 3-4 months.

Defence

This species possesses a pair of metathoracic glands, which are used for defence. The acrid smelling fluid which can be released as a fine mist up to 30cm away from the insect. The effects of the spray however can be experienced up to 60cm away. Contact results in irritation of the nasal membranes, and eye irritation. I am not aware of any data regarding the result direct eye contact from the defensive spray of this species.



Figures 1 & 2.
Outline drawings of *Anisomorpha monstrosa* Hebard, **1.** Female, **2.** Male.

Foodplants

Privet (*Ligustrum* sp.) appears to be the most successful foodplant. Bramble (*Rubus sp.*) is also taken with good results. When both foodplants are offered Privet is usually taken in preference. There is no data on the natural diet of this species.

Rearing

This species is easy to rear, however the conditions required are quite different from those of *A. buprestoides*. Best results are obtained with the use of tissue paper on the base of an airy cage, kept moist resulting in a relatively high humidity, without condensation. It is probably best not to spray the insects directly as this usually triggers the defence mechanism, however light spraying of the foodplant can be used to supply extra moisture. This species is undemanding with regards to temperature, 65-75°C being adequate for growth, egg production and incubation. This species is relatively easy to keep and a culture can be maintained in a fairly small cage.

Egg laying

The reproductive and egg laying behaviour in this species is particularly fascinating and follows the pattern for the other species in the genus. The male will usually mate with an immature female, and remain attached throughout the remainder of her life. Once a female reaches adulthood egg laying can take up to 4 weeks to commence. The act of egg laying is initiated when the female curls her abdomen over her head, complete with the male. The egg appears at the tip of the abdomen, and can be held for up to 30 seconds, before the abdomen contracts and ejects the egg up to 10cm away. Each female lays approximately 15 eggs per week. In my experience this species does not bury its eggs.

Acknowledgements

Thanks to Kim D'Hulster, Kristien Rabaey and Phil Bragg for helpful discussions and information supplied.

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Cigarrophasma, a new genus of stick-insect (Phasmatidae) from Australia

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Abstract
An interesting new species of cigar-like appearance from Garradunga, north Queensland, Australia, is described in a new genus *Cigarrophasma*. The single representative, *C. tessellata* n.sp., is designated type species for the genus, which is similar in general appearance and allied to *Phasma* Lichtenstein, 1796. Brief notes are given on habits and life history.

Key words
Phasmida, *Cigarrophasma* new genus, *Cigarrophasma tessellata* new species, taxonomy.

Introduction

The Phasmida (stick and leaf-insects) is an order of approximately 3000 species, relatively poorly represented in museum collections, with many species described from unique specimens; consequently it is not surprising that the taxonomy is regarded as confusing, with new synonyms often reported in the literature (Brock, 1999). The Australian fauna is understudied. Vickery (1983) catalogued 98 Australian species; Balderson, Rentz & Roach (1998) listed an additional six species. Brock (1999) estimated that there are over 200 species in Australia. Over half of the described Australian fauna are found in Queensland, where this new species was located.

Material and methods

The present study deals with a new genus and species of Australian phasmid from the family Phasmatidae, first collected by Paul Hasenpusch and later also by Jack Hasenpusch (Garradunga, Innisfail, north Queensland) in the same rainforest habitat. Most of the type series has been deposited in the Queensland Museum, Brisbane [QM]. Several major museum collections in Australia were examined for material by me (curators or contact names in brackets): Australian National Insect Collection, Canberra [ANIC] (D.C.F. Rentz); Australian Museum, Sydney (S. Fellenberg); Darwin Museum & Art Gallery (G. Brown); Queensland Museum, Brisbane (G. Monteith); Western Australian Museum, Perth (T.F. Houston). The private collection of T. Hiller (Mt. Glorious, south-east Queensland) was also examined, along with many world-wide collections. However, no additional specimens were traced.

Cigarrophasma New genus

Phasmatidae, Phasmatinae, Phasmatini

Description of genus

Large, fairly broad winged species. Head large, longer than wide, tuberculate; eyes average size, ocelli absent. Antennae long, but shorter than length of fore leg; basal segment broader than remaining segments.

Thorax broad in female. Pronotum slightly shorter than head, tuberculate, with central depression; Mesonotum approximately three times length of pronotum, with a variable number of large, brown, spine-like tubercles: the front pair are longer and broader than others, particularly in male, and curved forwards; there are a number of other spines, larger in male, and numerous tubercles. Metanotum shorter than mesonotum with smaller granulations. Fore wings long and ovate, much broader in female. Hind wings moderately

long, tessellated, dark brown and transparent. Legs robust and spiny, lobed in female, moderately long in male, shorter and broader in female. Fore legs considerably broadened in female. All femora with bold pair of apical spines, longer in male; and large subapical spines. Tibiae lobed in female. Tarsi of modest length, first segment of fore tarsi lobed in female.

Abdomen slender in male, end of anal segment slightly incised in centre. Subgenital plate swollen, raised in centre, then tapered to slightly rounded tip, exceeding end of 9th abdominal segment. In female body broader, 5th segment rounded laterally, 7th and 8th segments sometimes with large lateral leaf-like expansions towards end of segments. End of anal segment subtruncate; supra-anal plate visible, strongly triangularly incised in centre. Operculum broad, end slightly rounded, almost reaching end of anal segment. Cerci short in both sexes.

Type species: *Cigarrophasma tessellata* **n.sp.**, here designated.

Distribution

Monotypic, Australian endemic, north Queensland.

Remarks on the genus

This genus has a similar appearance and is allied to *Phasma* Lichtenstein, but is easily distinguished from that genus by certain key features (Table 1). *Cigarrophasma* does not appear to be very closely related to existing genera in the tribe Phasmatini of the Phasmatinae, most of which have large, leaf-like cerci in one, or both sexes.

It is possible that this species belongs to a different tribe, as it differs from other genera in the Phasmatini by its shorter cerci and lack of ocelli in the male. However, apart from these features, it is very similar to *Phasma* in general appearance (and significantly differs from other tribes in the Phasmatinae, which have wings strongly reduced in the female) that I prefer to allocate it to the Phasmatini. This stance is further supported by general similarity in egg capsule shape and size. However, the eggs of *Cigarrophasma* lack the capsule sculpturing present in *Phasma*, whose capitulum is raised by a small stalk. The stalk is also absent in *Vetilia* Stål, which has a much larger capitulum than *Cigarrophasma*.

Paracyphocrania Redtenbacher, 1908 is possibly more closely related, but is only briefly described, based on a single 140mm specimen of *P. lativentris* Redtenbacher of unknown origin, which has since been destroyed. The description differs from this new Australian genus, although both have short cerci and tessellated wings. The new genus is much more tuberculate, with the lateral expansions on abdominal segments absent in *Paracyphocrania*, which has leaf-like cerci.

Feature	*Cigarrophasma*	*Phasma*
General appearance	Reasonably long (♀ up to 151mm) and broad, with numerous tubercles. Hind wings dark brown and transparent chequered. Ocelli absent.	Elongate (♀ up to 200 mm), with modest number of bold spine-like tubercles or spines. Hind wings yellow and black chequered. Male with ocelli present.
Legs	Modest size, very broadened in female and reasonably lobed.	Long and spiny; some lobation.
Cerci	Short in both sexes (1.5mm).	Large, leaf-like (up to 18mm).

Table 1. Comparison of *Cigarrophasma* **n.gen.** and *Phasma* Lichtenstein.

Cigar Stick-insect

Cigarrophasma tessellata n.sp.

Holotype ♂ (QM), Stone Creek, Garradunga, Innisfail, north Queensland, 6.i.1995, P. Hasenpusch. Paratypes (15): [Abbreviations used for collectors: JH = Jack Hasenpusch; PH = Paul Hasenpusch]. From same locality as holotype: ♂ 19.i.1995 PH (QM); 2♂♂ 2.ii.1995 PH (QM), ♀ 15.i.1993 PH (QM); ♀ 24.ii.1994 JH (QM), 3♂♂ 16.i.1994 JH (QM); ♂♀ 16.1.1994 JH (ANIC); 2♂♂ 24.ii.1994 JH (P.D. Brock); ♀ 12.xii.1992 JH (P.D. Brock); Polly Creek, Garradunga, Innisfail, north Queensland: ♂♀ 10.iii.1999 JH (P.D. Brock).

Description of male (Figures 1-3)

Attractive brown, medium-sized insect, with spiny tubercles on mesonotum and chequered wings; 108mm long.

Large, fairly broad winged species. Head large, longer than wide; eyes average size, ocelli absent. Central narrow white line, not reaching front of head. Hint of white line either side, reaching back of head, but only 1.5mm long. Head with numerous tubercles. Antennae long, but shorter than length of fore leg; basal segment broader than remaining segments.

Pronotum slightly shorter than head, with central depression; segment with many tubercles. Mesonotum three times length of pronotum, with numerous large brown tubercles; the front pair are longer and broader than others and curved forwards. Metanotum shorter than mesonotum with smaller granulations. Lateral margins of meso- and metathorax with series of small tubercles. Underside of thorax with small tubercles. Fore wings long and ovate. Pre-anal part of hind wings greenish brown; inner margin with black blotch surrounding triangular transparent area. Hind wings moderately long, reaching end of 6th abdominal segment; tessellated, dark brown and transparent. Legs robust and spiny, moderately long. All femora with bold pair of apical spines and large subapical spines. The mid and hind femora are much spinier than fore femora; same applies to tibiae.

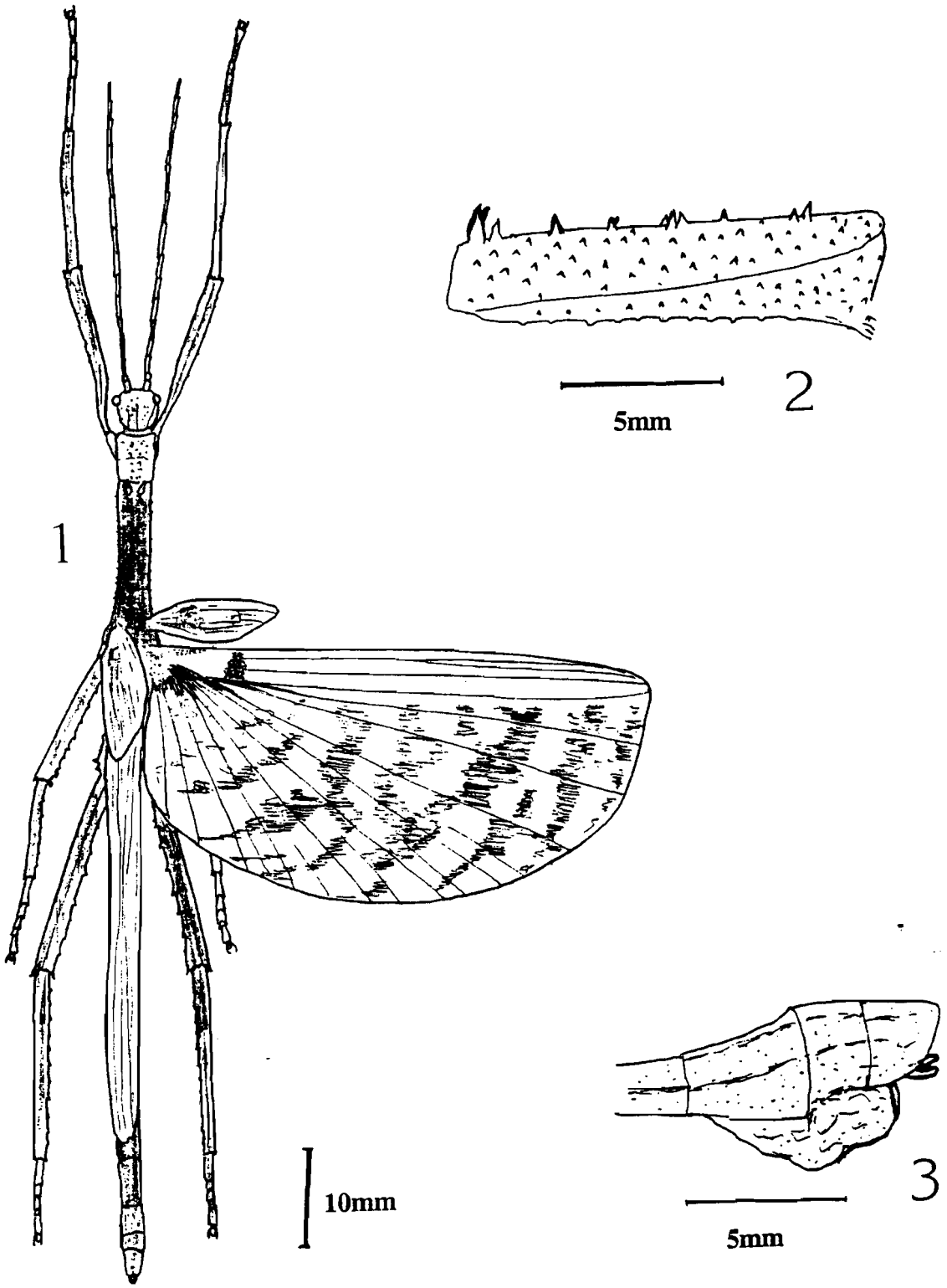
Abdomen slender, granulated and with various ridges, end of anal segment slightly incised in centre. Subgenital plate swollen, raised in centre, then tapered to slightly rounded tip, exceeding end of 9th abdominal segment. Cerci short and stout, incurved; rounded at tip.

Paratype males: Same description as holotype, but variable in size (see Table 2) and sometimes colour (see Remarks on the species).

Description of female (Figures 4-5)

Large, fairly broad-winged species. Head large, longer than wide, whitish; eyes brown, average size, ocelli absent. Head with numerous tubercles. Antennae long, but shorter than length of fore leg; basal segment broader than remaining segments.

Thorax brown, broad. Pronotum slightly shorter than head, with central depression, sometimes whitish, like head; segment with many tubercles. Mesonotum 3 times length of pronotum, with numerous brown tubercles; usually with two or three spines near front of segment broader and darker than others. Metanotum shorter than mesonotum with smaller granulations. Lateral margins of meso- and metathorax with series of small tubercles. Underside of thorax with small tubercles. Fore wings greenish brown (light or dark), broad and ovate. Hind wings almost reaching end of 5th abdominal segment; tessellated, dark brown and transparent. Legs robust and spiny, relatively short and broad with various lobes. Brown or brown and whitish speckled or blotched. Fore legs considerably broadened. All femora with pair of apical spines. Mid and hind femora with large subapical spines. Mid and hind femora lobed towards hind part of upper surface. Tibiae lobed; mid and hind tibiae



Figures 1-3. Male *Cigarophasma tessellata*. **1.** dorsal view of holotype; **2.** lateral view of mesothorax; **3.** lateral view of end of abdomen.

with pair of lobes near base and apice. Tarsi of modest length, first segment of fore tarsi broadened.

Abdomen broad with numerous tubercles on upper and underside. 5th segment rounded laterally, 7th and 8th segments with large, lateral leaf-like expansions towards end of segments (much shorter on 6th segment - expansions on 7th and 7th segments absent in one paratype). End of anal segment subtruncate; supra-anal plate visible, strongly triangular incised in centre. Operculum broad, end slightly rounded, almost reaching end of anal segment. Cerci broad, rounded at tip. Measurements are given in Table 2.

Description of nymphs

The nymphs are reddish brown throughout all stages, but colours vary (see remarks on page 10) depending on host food plants.

Table 2

Lengths (mm)	Holotype ♂	♂ paratypes	♀ paratypes
Body length	108	93-102	134-151
Head	6	5-6	9-10
Antennae (tips often broken off)	30	30-32	33-36
Pronotum	5	4.5-5	8.5-9
Mesonotum	16	15-16	22-25
Metanotum	9	9	9-10
Median segment	5	5	8
Fore wing	16	15-16	25-28
Hind wing	60	52-60	58-65
Fore femora	21	19-21	21-23
Mid femora	17	15-17	17-19
Hind femora	25	22-25	22-25
Fore tibia	21	17-21	17-20
Mid tibia	15	12-15	13-15
Hind tibia	22	18-22	19-21
Fore tarsi	18	11-18	13-14
Mid tarsi	10	7-10	10-12
Hind tarsi	12	9-12	11-14
Cerci	1.5	1.2-1.5	1.5

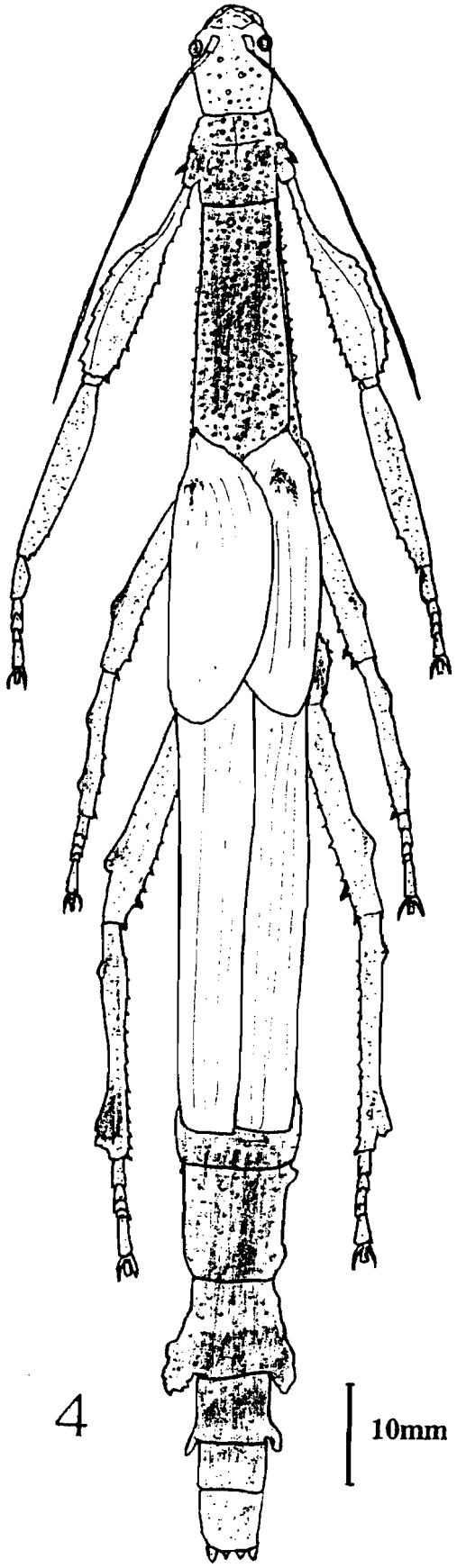
Description of egg (Figures 6-7).

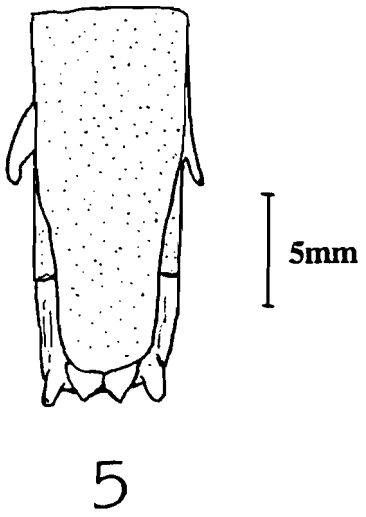
Glossy, dark brown or black almost spherical capsule. Operculum flat, with short capitulum. Micropylar plate a large central whitish or brown band extending from operculum rim to the posterior pole. Capsule length 3.3mm, width 2.5mm, height 3mm.

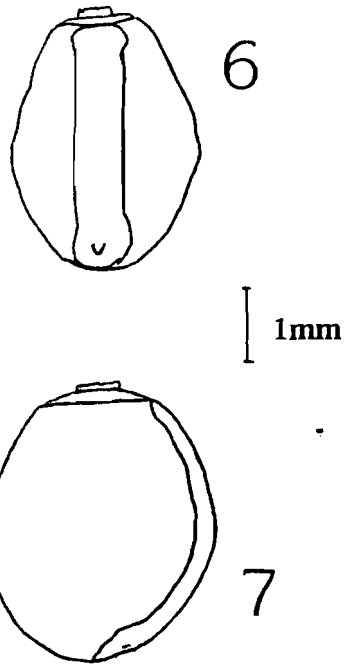
Remarks on the species

Food plants include *Calliandra* (Mimosaceae), guava *Psidium* sp. (Myrtaceae) [neither native to Australia], *Cardwellia sublimis* and *Buckinghamia celcissima* (both Proteaceae). These insects are easy to rear in captivity, with eggs hatching in approximately four months. The nymphs mature in five months (for general rearing advice on phasmids, see Brock (1999)).

When disturbed, nymphs drop from the food plant and feign death by lying on the ground. Larger nymphs and adults tend to rest on a branch facing the main trunk of food plants. The body is kept raised well above the branch and the mid legs tucked underneath the body. The end of abdomen is typically raised, with a white spot at the end, resembling







Figures 4-7. *Cigarrophasma tessellata*. **4.** Female, dorsal view; **5.** End of abdomen, ventral view, **6.** Egg, dorsal view, **7.** lateral view.

bracken. Remaining motionless in the daytime and resembling their surroundings appears to be the main defence strategy. Adults have not been observed flashing their wings open; indeed, they hold onto branches tightly and are reluctant to move unless physically grabbed. Colour variation in adults and nymphs has been linked with colours of the host food plants in the wild; insects on *Calliandra* range from ashen grey to green, compared with purple-brown with deep green streaks when feeding on *Cardwellia*.

The known distribution is limited to Garradunga, near Innisfail, north Queensland. The male has previously been illustrated in a photograph, as an un-named species being set (Brock, 1999: 46).

Etymology

The genus is based on *cigarro* - cigar (due to the female's cigar-like appearance) and *phasma*, meaning apparition, on account of its affinity with the genus *Phasma*. The specific name *tessellata* relates to the mosaic patterned hindwings of this species. The common name 'Cigar Stick-insect' is an ideal name for this species.

Discussion

This is an interesting new species from Garradunga, belonging to the family Phasmatidae, in an understudied fauna. Brock (in press) describes two further species from the same locality. There still remain a number of interesting undescribed Australian species, including large insects. It is hoped that enthusiasts will try to record the life history and habits, which considerably add to our knowledge of genera.

Acknowledgements

The authors would like to thank a number of museum curators who have allowed access to the collections.

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A review of the genus *Medaura* Stål, 1875 (Phasmatidae: Phasmatinae), including the description of a new species from Bangladesh

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Abstract

The genus *Medaura* Stål, 1875 is reviewed. Keys are provided to distinguish adults and eggs of the two species, which includes *M. jobrensis* - a new species from the Chittagong region, Bangladesh. It is pointed out that both species vary considerably in the degree of lobes and tubercles present, hence *Medaura nimia* Brunner, 1907 and *Medaura subintegra* Carl, 1913 are listed as new synonyms of *Medaura scabriuscula* (Wood-Mason, 1873) from India and Bangladesh. *Medaura brunneri* Stål, 1875 is confirmed as a synonym of *M. scabriuscula*, whose male is described for the first time. Figures of adults and eggs are provided.

Key words

Phasmida, *Medaura* review, *key to genus, Medaura jobrensis* n.sp.

Introduction

Cliquennois (1999) published an account of collecting phasmids in Bangladesh, which included provisional identification of species collected. Following detailed research on the genus *Medaura* Stål, 1875, including rearing a series of specimens from the Chittagong and Sylhet regions of Bangladesh, and examination of type material in various museum collections, it is now possible to resolve errors in the literature. These have resulted from the belief of some authors that variation in tubercles and lobes, even in species from close geographical proximity, is sufficient to rank specimens as distinct species.

This paper describes and illustrates eggs and adults of a new species and the other valid *Medaura* species.

Methods

Research has been undertaken as follows, i) examining the literature on phasmids; ii) checking type and other material, where possible; and iii) breeding a series of *Medaura* species from insects collected from Sharighat, Sylhet region, and the University of Chittagong grounds, Jobra, in the Chittagong region of Bangladesh. The Chittagong region has received little attention from insect collectors in the past, whereas historic collections from "Silhet", then in India, were frequent. For instance, Brunner's collection (Naturhistorisches Museum Wien) includes several species collected in Silhet by Deyrolle, a well known insect dealer in Paris; the region is now known as Sylhet.

The first stage of a detailed evaluation of the literature uncovered a confusing situation similar to those often encountered in phasmid taxonomy. One must research and decide whether Brunner and Redtenbacher (authors of the monograph on the order, published in three parts between 1906-08) correctly assessed the status of species, or whether there is a contradiction with publications such as Kirby's Catalogue of species, published in 1904, but not referred to by Brunner and Redtenbacher. In this case Brunner (1907) regarded *Medaura brunneri* Stål, 1875 as a valid species, although Wood-Mason (1877) had already synonymised it with his *Bacillus scabriusculus*, described in 1873 (at the same time erecting a new genus *Menaka*); a treatment accepted by Kirby (1904), except that he considered the genus *Medaura* as still valid.

Breeding a series of specimens is invaluable to review any variation. This proved our theory that *Medaura* species are remarkably variable, assisting our decision on which taxa are valid.

The following abbreviations have been used for museum collections:

BMNH Natural History Museum, London, U.K.
MHNG Muséum d'Histoire Naturelle, Geneva, Switzerland.
NHMW Naturhistorisches Museum Wien, Vienna, Austria.
NZSI National Zoological Collection, Zoological Survey of India, Calcutta, India.
OXUM Oxford University Museum, Oxford, UK.

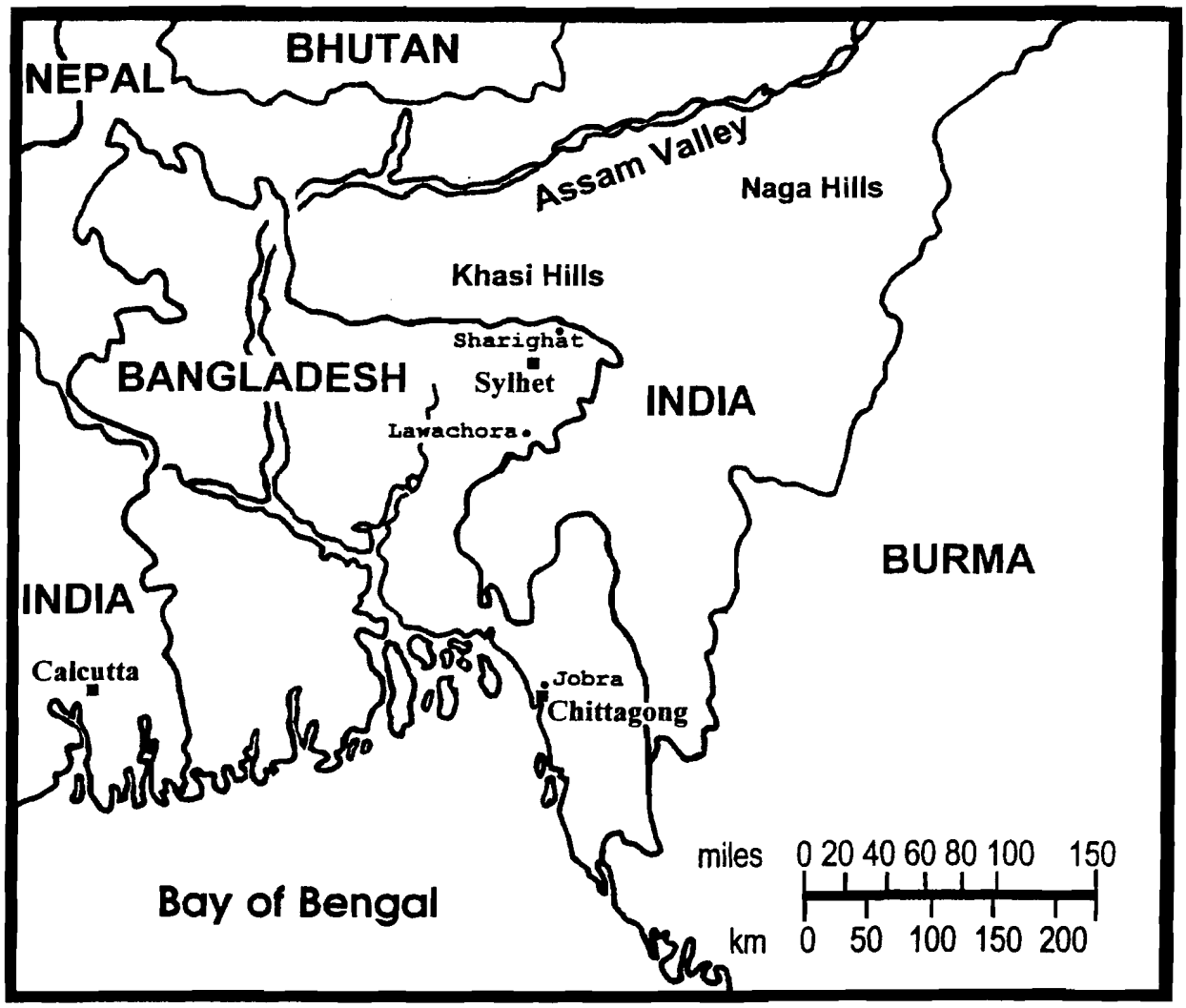


Figure 1. Map showing main localities in Bangladesh and neighbouring parts of India.

Medaura Stål, 1875

Medaura Stål, 1875: 69, as a subgenus of *Stheneboea* Stål, 1875. Type species: *Stheneboea (Medaura) brunneri* Stål, 1875: 69, designated by Kirby (1904: 341) under the senior name *Bacillus scabriusculus* Wood-Mason, 1873: 55, pl. 7: 1.
Medaura Stål; Brunner, 1893: 94 [elevated from subgenus to genus].
Menaka Wood-Mason, 1877: 342. Synonymised by Kirby, 1904: 341.

Stål listed two species in his new subgenus *Medaura*: *Stheneboea (Medaura) brunneri* and *S. (M) praon* (Westwood, 1859) without specifying the type species for the genus; the latter was

returned to *Lonchodes* Gray, 1835 by Brunner (1907). Stål's brief description of *Medaura*, in Latin, is as follows: "Tibiis anticis sulco percurrente instructis, superne haud foliaceo-dilatatis; capite inter oculos bispinoso; tarsis longioribus quam in divisione praecedente, articulo primo quinto longiore; femoribus posterioribus in linea media subcarinatis et interdum prope apicem denticulatis; tibiis, plerumque quoque femoribus, intermediis prope basin lobo foliaceo magno destitutis; operculo feminae posterius haud vel minus declivi, vel ibidem depresso; mas gracilior, pedibus lobis destitutis".

Whilst Stål has remarked on features such as the double-spined head, lobes and spines on the mid-legs and relatively minor variations compared with *Stheneboea*, the two genera are easy to distinguish from the antennae length, which are always shorter than the fore femora in *Medaura* (which belongs to the Phasmatidae, subfamily Phasmatinae), but much longer in *Stheneboea*, since shown to be a synonym of *Prisomera* Gray, 1835 (Heteronemiidae: Lonchodinae). However, they otherwise look similar in general appearance, so caution must be exercised if examining specimens with broken antennae. Normally though it is possible to distinguish them by lobes on the mid femora: *Prisomera* species have the largest lobes basally, unlike *Medaura* species, which have a small basal lobe.

The more robust appearance of these insects distinguishes them from their closest allies *Medauroidea* Zompro, 1999 (represented by a single species: *M. extradentata* (Brunner, 1907), previously belonging to the genus *Baculum* Saussure, 1861). It is understood that *Baculum* is being examined elsewhere (Zompro, pers. com.), but there are doubts concerning variation between the type species and taxa subsequently described (Brock, 1995). This genus needs to be split into various genera, based on an examination of morphology and egg differences. There are also numerous new synonyms to record, mainly as a result of authors describing species based on one sex. *Medauroidea extradentata* is another species variable in colour form and morphology. This species is widely reared, particularly in Europe. However, *M. extradentata* are slenderer than *Medaura* species and the eggs more oval-shaped and considerably more ornate, with the micropylar plate almost circular (the eggs significantly differ from known eggs of other species currently recognised as belonging to *Baculum*, confirming Zompro's action in transferring *extradentata* to a new genus).

Brunner (1907) listed three *Medaura* species: *M. brunneri* Stål, his new species *M. nimia* and *M. austeni* (Wood-Mason, 1875) the latter listed with uncertainty. *M. austeni* is not a *Medaura* species, nor a *Promachus* Stål, 1875 species, as indicated by Kirby, 1904. It is only known from a male (type locality - Dikrang valley, Assam, India) which has long antennae, in addition to a series of abdominal and some thoracic spines. This species is closely related to *Prisomera aspera* (Brunner, 1907), known from a single female from Sikkim, India. Various other species have also historically been associated in error with *Medaura*: *Medaura stali* Brunner, 1893 from Pegu in Burma (now known as Myanmar) was transferred by Brunner (1907) to the genus *Pachymorpha* Gray, 1835 (and later associated with *Hemipachymorpha* Kirby, 1904). Kirby (1904) doubtfully associated two species with *Medaura*: *M. darnis* (Westwood) from Sarawak (transferred to *Pachymorpha* Gray by Brunner, 1907) and *M. makassarinus* (Westwood, 1859) from Macassar, which is related to *darnis*.

The difficulties with Brunner and Redtenbacher (1906-08) have already been briefly discussed in 'Methods'. Unfortunately, it has not been possible to examine the holotype of *Bacillus scabriusculus* Wood-Mason, but the figure provided agrees with Brunner's drawing (pl. 11.2) of *M. brunneri*, taking into account variation of features such as the extent of leg lobation within this species. It is likely that when describing *M. brunneri* from Silhet in 1875, Stål was unaware of Wood-Mason's 1873 paper. In 1877 Wood-Mason examined material from Silhet (possibly from the same source as Stål) and decided that his material

agreed with Stål's description. *M. brunneri* is therefore confirmed as a synonym of *M. scabriuscula*.

The Naga Hills in India (type locality of *M. scabriuscula*) are relatively close to the border of Bangladesh (see figure 1) and there is a reasonable overlap of species in both countries (Cliquennois, 1999). We consider that Sylhet material agrees with specimens from Assam, hence new synonyms from India are *M. nimia* Brunner, 1907 and *M. subintegra* Carl, 1913. This takes into consideration variations in leg lobation highlighted in Brunner's key to species (and discussed by Carl), but confirmed by the rearing of a series of specimens to be merely variations.

Description of the males of *Medaura*

Head much longer than wide, with spines absent or a very short pair of spines or tubercules between eyes. Antennae length variable, but shorter than fore femora; first two segments elongated and considerably broadened. Thorax elongate, with (few to many) tubercles and / or granulations. Mesonotum about twice the length of the metanotum. Median segment about one quarter of the length of metanotum. Legs elongate, with slight dentations on femora and / or tibiae. Abdomen elongate, smooth to slightly granulated. Segments 8-9 widened. End of anal (10th) segment incised in centre.

Description of the females of *Medaura*

Head slightly longer than wide, with a pair of spines between eyes. Antennae short, less than half of the length of the fore femora; first two segments elongated and considerably broadened. Robust appearance, thorax smooth, slightly granulated or tuberculate. Mesonotum about twice length of metanotum. Median segment about one quarter of the length of the metanotum. Legs elongate, with minor dentation except for mid legs, which usually have a series of large thorn-like lobes on dorsal surface of femora (although sometimes completely absent in some specimens). Also with one or two shorter thorn-like lobes on mid tibiae. Abdomen robust, smooth to slightly granulated. End of anal segment incised in centre; shape variable. Operculum long, almost reaching end of anal segment.

Key to males of the genus *Medaura*

1. Elongate, thorax typically tuberculate. Mid femora with series of 3-4 small subapical spines. End of anal segment slightly incised in centre (or sometimes boldly incised but anal segment always tapered towards tip). . . . . *M. scabriuscula*
- More robust, thorax typically with sparse granulations. Mid femora with single small subapical spine. End of anal segment boldly incised in centre; segment slightly rounded, not sharply tapered. . . . . *M. jobrensis* **n.sp.**

Key to females of the genus *Medaura*

1. Robust, thorax with modest number of granulations or tubercules. End of anal segment split into two leaf-like lobes. . . . . *M. scabriuscula*
- More robust appearance, thorax with few to many granulations or tubercles. End of anal segment slightly triangularly incised in centre; but uneven. . *M. jobrensis* **n.sp.**

Note - whilst submitting the manuscript of this paper, it has been brought to our attention that Zompro (1998) has briefly noted a possible new *Medaura* species from the Nakhon Ratchasima region of Thailand.

Key to eggs of the genus *Medaura*

1. Capsule length 3mm, completely dotted with large pits. Micropylar plate heart shaped (fig. 8). . . . . *M. scabriuscula*
- Capsule length 2.5mm, dotted with pits, except within micropylar plate. Micropylar plate not quite heart shaped (fig. 16). . . . . *M. jobrensis* **n.sp.**

Medaura scabriuscula (Wood-Mason) (Figures 2-9)

Bacillus scabriusculus Wood-Mason, 1873: 55, pl. 7.1 (♀). Holotype ♀, India: Naga Hills, Assam, leg. Captain Butler (NZSI: believed lost).

Menaka scabriuscula; Wood-Mason, 1877: 342 [transferred to new genus].

Medaura scabriusculus; Kirby, 1904: 341 [catalogue of species].

Bacillus scabriusculus; Brunner, 1907: 241 [listed as possibly the same as *Medaura nimia* Brunner, 1907].

Stheneboea (Medaura) brunneri Stål, 1875: 69. Holotype ♀, India: Silhet, leg. Deyrolle (NHMW, 449) [examined].

Stheneboea brunneri; synonymised by Wood-Mason, 1877: 342. [listed as a synonym of *Menaka scabriuscula*].

Stheneboea (Medaura) brunneri; Kirby, 1904: 341 [listed as synonym of *Medaura scabriusculus*].

Medaura brunneri; Brunner, 1907: 241, pl. 11.2 (♀) [key to species].

Medaura nimia Brunner, 1907: 241. Holotype ♀, India: Calcutta?, leg. Thorey (NHMW, alcohol coll.) [examined]. **New synonym**

Note - locality considered doubtful by Brunner who added '?' after Calcutta. He also doubtfully linked his new species with Wood-Mason's *scabriusculus*.

Medaura subintegra Carl, 1913: 20. Holotype ♀, India: Khasi Hills, Assam (MHNG) [examined]. **New synonym**

Other material examined:
♂,♀ Bangladesh: Sharighat, Sylhet, 01.viii.1999, leg. N. Cliquennois (NHMW); ♂, ♀ same locality & collector, 31.vii-01.viii.1999 (NHMW); ♀ Sylhet Town, Sylhet, 27.vii.1999, leg N. Cliquennois (P.D. Brock); ♀ Silhet, no further details (OXUM).

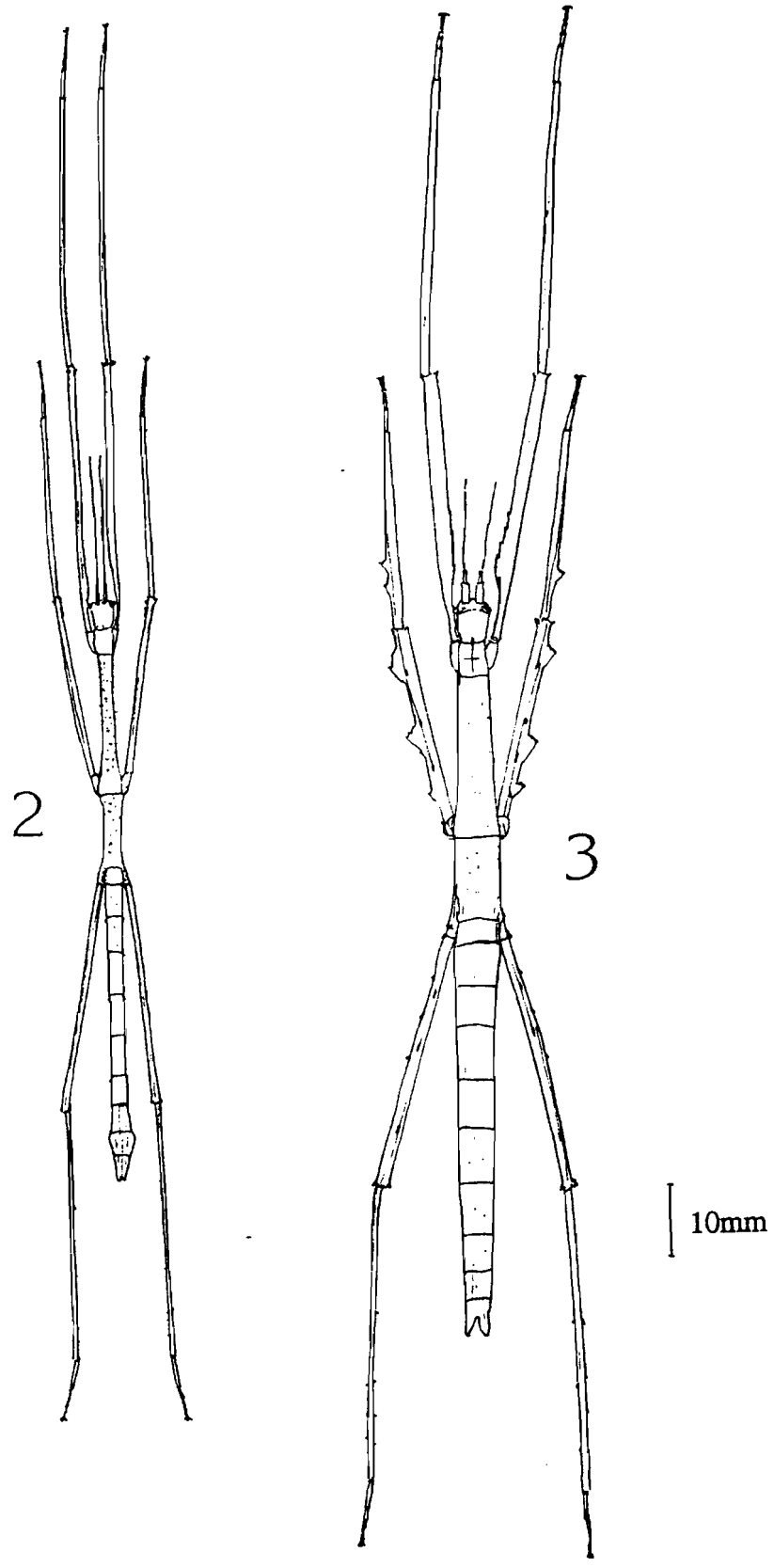
Description of male

Dark brown, thorax may be lighter.

Head one and a half times longer than wide, slightly elevated between eyes, otherwise smooth or sparsely granulated; posterior margin with central depression. Eyes small. Antennae shorter than fore femora, with 22 segments. First two segments considerably broadened, but elongate.

Pronotum slightly shorter than head with several bold tubercles and depressions (tubercles almost absent in some specimens). Tubercles mainly central but posterior margin with semicircular row of tubercles. Mesonotum six times length of pronotum, elongate with numerous darker tubercles. Metanotum just over half the length of the mesonotum, again with tubercles, but mainly on upper half. Median segment short, about one quarter of the length of the metanotum. Underside of thorax sparsely granulated.

Abdomen elongate, with sparse tubercles or granulations (sometimes almost absent). Segments 8-9 widened. Anal segment tapered towards tip, which is incised in centre. This varies from a slight to bold incision but the anal segment is always tapered towards tip. Subgenital plate rounded, reaching end of 9th segment; when viewed laterally there is a clear



Figures 2 & 3. *Medaura scabriuscula* (Wood-Mason), adults. **2.** Male; **3.** Female.

central protuberance. Cerci short, hidden beneath anal segment; tip rounded.

Legs elongate, slightly hairy; all with pair of apical spines. Mid and hind femora with subapical spines, 3-4 present on mid femora, 1-2 on hind femora. Femora and tibiae variable, but usually with very minor dentation.

Description of female

Variable shades of brown, thorax may have lighter areas with a dark raised median line; legs sometimes mottled.

Head thick, slightly longer than wide, armed between the eyes with two bold spines, projecting outwards and slightly backwards. Sparse tubercles and granulations present. Eyes small. Antennae short, less than half the length of the fore femora, with 18-19 segments; first two segments considerably broadened, but elongate; first segment particularly long (3mm).

Pronotum slightly shorter than head with central depression and coarsely granulated. Mesonotum and metanotum wrinkled longitudinally with small tubercles or granulations. Mesonotum more than four times length of pronotum, widening gradually posteriorly. Metanotum about half the length of the mesonotum. Median segment short but more than one quarter of the length of the metanotum. Underside of thorax sparsely granulated.

Abdomen with numerous small tubercles or granulations. Abdominal segments 8 and 9 slightly shorter in length; anal segment longer than 9th and tip boldly triangular incised in centre, giving it the appearance of having two leaf-like lobes. Operculum long, tapered towards tip, which is slightly pointed and reaches just beyond start of central incision. Cerci short, hidden beneath anal segment; tip rounded.

Legs elongate, slightly hairy; all femora with pair of apical spines. Upper half of fore femora slightly serrated. Mid femora with three large dentate foliaceous lobes dorsally and three small spines on the central carina, opposite to the foliaceous lobes. The hind femora have some small spines on each of the upper crests. Dorsally the mid tibiae have two smaller foliaceous lobes at the proximal end, and ventrally, a single spine at the proximal end; other minor spines feature on femora (including subapical spines) and tibiae. The femora and tibiae are variable, usually with very minor dentation, but in extreme cases this is absent (where legs have been regenerated this is normally the case, but such legs are usually shorter than normal length).

Description of egg

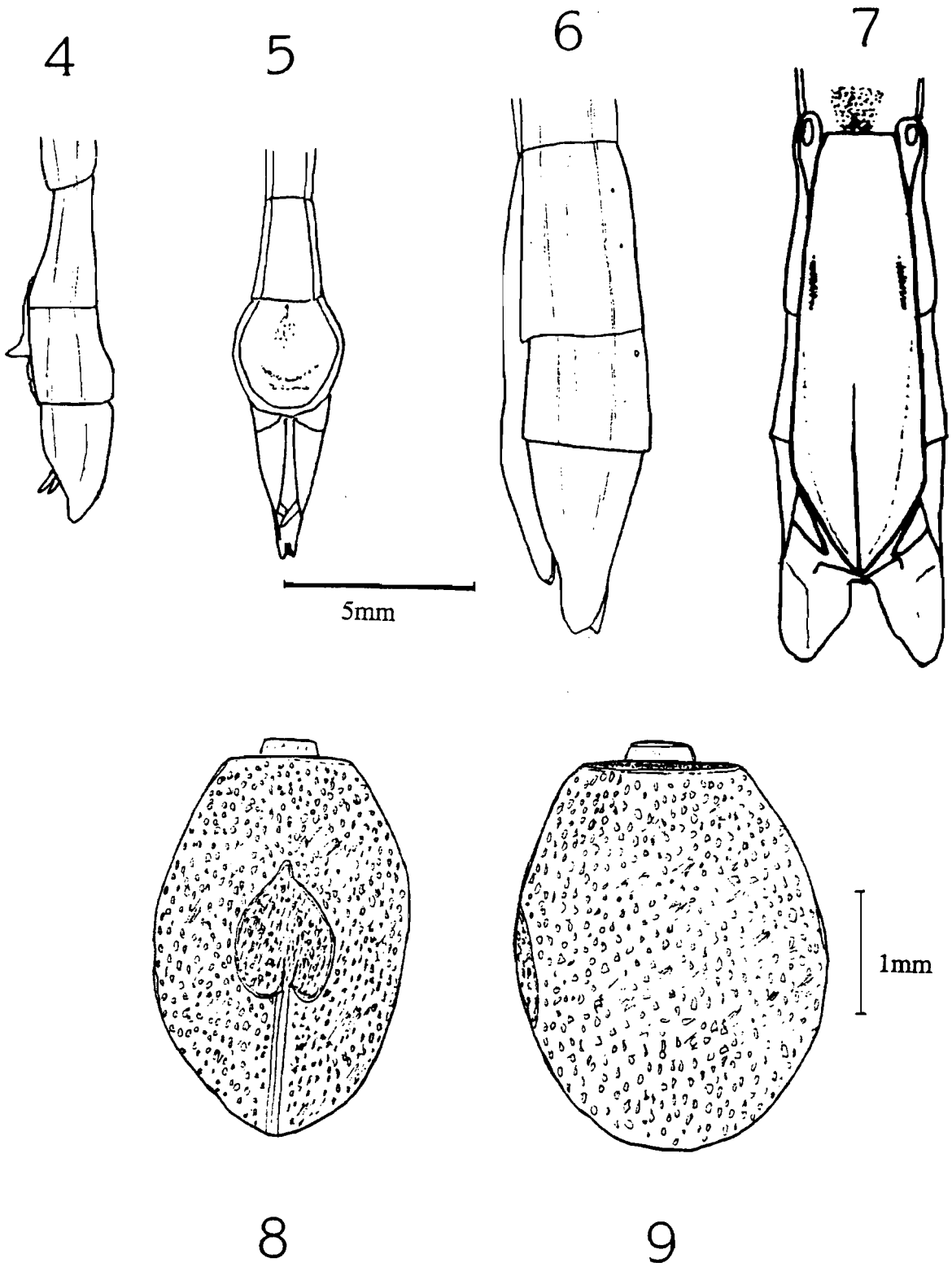
Various shades of brown, including some small darker patches. Capsule almost oval; completely dotted with numerous large darker brown pits. These pits are situated close together, including within the heart-shaped micropylar plate, which is the same colour as the capsule. Plate joined by a long median line. Capitulum dark yellowish-brown, with the top black. Operculum black, with brown inner ring. Measurements: length 3mm, width 2mm, height 2.5mm.

Distribution

Type locality: Naga Hills (Assam), India. Widely distributed in Assam region of India and possibly more widespread. Common in Sharighat, Sylhet, Bangladesh, and also found in Sylhet Town.

Notes

i) Foodplants. In the wild these include *Eupatorium odoratum* (Compositae), *Allophyllus cobbi* (Sapindacae), *Litsea monopetala* (Lauraceae) and various as yet unidentified



Figures 4-9. *Medaura scabriuscula*. **4-5.** End of male's abdomen, lateral & ventral; **6-7.** End of female's abdomen, lateral & ventral; **8-9.** Egg, dorsal & lateral.

plants. In captivity in Europe mainly fed on *Rubus fruticosus* (Rosaceae). In Bangladesh one male ate *Caesalpinia cucullata* (Caesalpiniacae).

ii) Colour variation. Males are various shades of brown. Females are usually much more variable, as follows: specimens seen include ones with white patches on the metanotum and / or anal segment. Examples with darker median lines are also occasionally observed. One had a broad orange-brown median band on the length of its body, also broad bluish blotches on the mesonotum and metanotum, with a tinge of blue on the abdominal segments; an unusual colour for a phasmid.

iii) This species is currently being reared within the Phasmid Study Group as culture 216.

Table 1. *M. scabriuscula*, adult measurements (mm).

	♂	♀		♂	♀
Body length	80-88	97-109	Fore femora	36	36-41
Antennae	4-4.5	5.5-6.5	Mid femora	25-27	25-30
Head	21-28	16-17	Hind femora	32	31-36
Pronotum	3-3.5	4.5-5	Fore tibiae	38-45	39-45
Mesonotum	18-20	21-24.5	Mid tibiae	25-30	25-30
Metanotum	10-11	10-12	Hind tibiae	35-45	39-44
Median segment	2-2.5	3-4	Cerci	0.8	1.2

Medaura jobrensis n.sp. (Figures 10-17)

Medaura brunneri?; Cliquennois, 1999: 52, figs 15-17. [not *brunneri* Stål, 1875].

Holotype ♂, Bangladesh: University of Chittagong, Jobra, Chittagong, ii-iii.1997, leg. N. Cliquennois (NHMW). Paratype series: ♀, same data (NHMW); ♂, ♀, same data except iii-iv.1997 (BMNH); ♀, same data, iii-iv.1997; ♂, 3♀♀, reared from Jobra, Chittagong region stock by P.D. Brock, iv.2000 (P.D. Brock). Note - in addition further reared specimens have been examined to ascertain the degree of variability within this species, but have not been preserved and therefore measurements have been excluded from those given below.

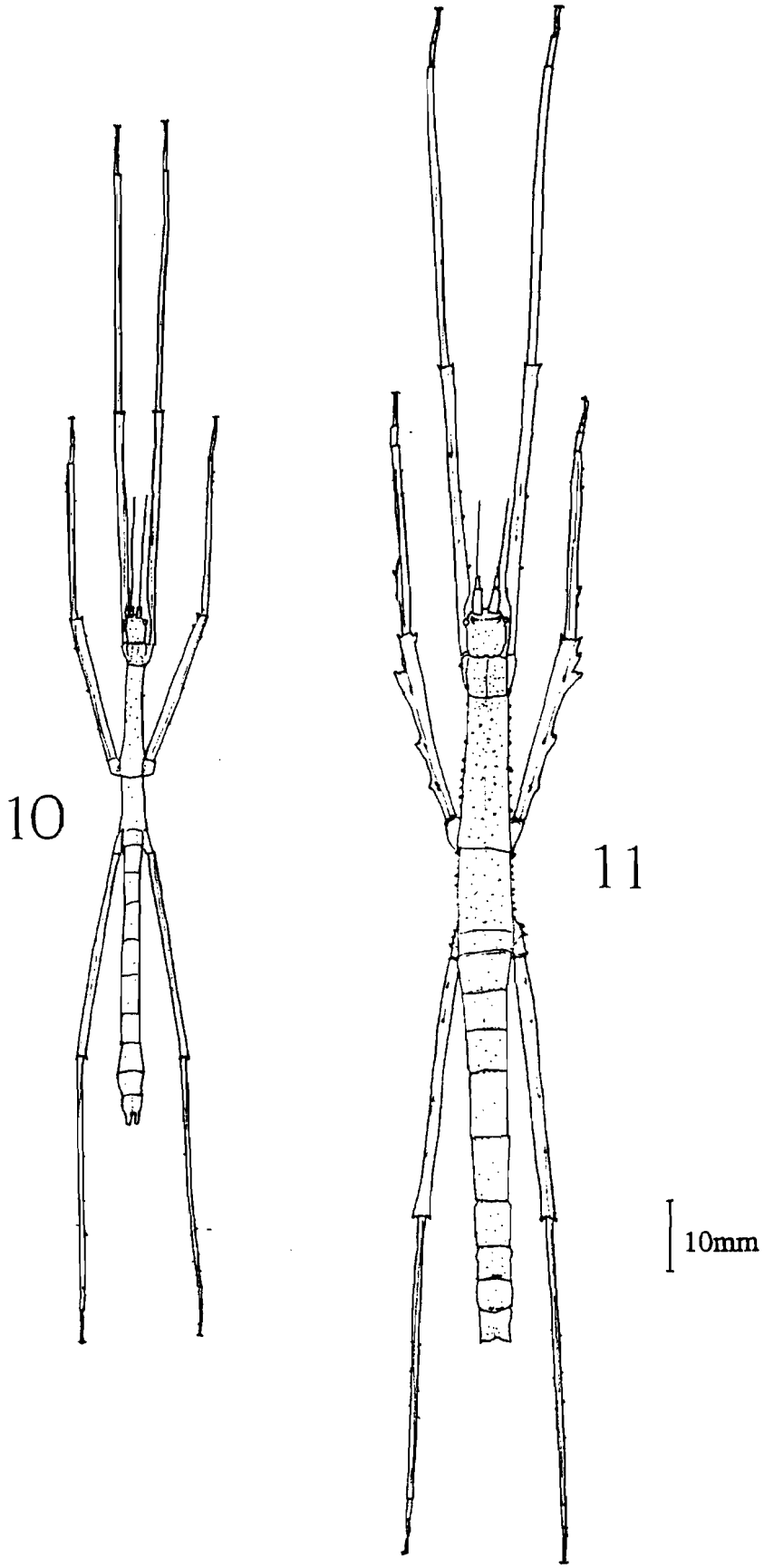
Description of male holotype

Dark brown, with lighter legs. Measurements given in Table 2.

Head one and a half times longer than wide, with pair of short tubercles between eyes, otherwise sparsely granulated; posterior margin with central depression. Eyes small. Antennae short, reaching just over half the length of the fore femora, with 23 segments. First two segments considerably broadened, but elongate; first segment larger.

Pronotum slightly shorter than head with several granulations and depressions. Mesonotum five times length of pronotum, elongate and sparsely granulated. Metanotum just over half the length of the mesonotum, slightly granulated. Median segment short, one quarter of the length of the metanotum. Underside of thorax sparsely granulated.

Abdomen elongate, sparsely granulated. Segments 8-9 widened. Anal segment slightly tapered towards the tip which is deeply incised in centre leaving two lobe-like structures with a large gap in between; each 'lobe' with several small dentations. End of subgenital plate



Figures 10 & 11. *Medaura jobrensis* **n.sp. 10.** Holotype male. **11.** Paratype female.

rounded, reaching end of 9th segment. When viewed laterally, plate is uneven, tapering sharply towards tip. Cerci short, hidden beneath anal segment; tips rounded.

Legs elongate, slightly hairy; all with a pair of short apical spines. Mid and hind femora with subapical spine. Femora and tibiae with minor dentations. Mid and hind femora with three small well spaced dentations on central carina, repeated on hind tibiae, which also have tiny subapical dentations. The proximal part of fore femora with slight dentations.

Paratype males

These show slight size variation, and variation in colour and dentation. Colour may be lighter brown, particularly on thorax and abdomen (and then usually with darker patches around hind part of metathorax and laterally along whole of thorax; also narrow red lines border a median longitudinal lighter coloured band, easier to distinguish on living specimens). The dentations can also be variable and the tubercles between the eyes can be hardly noticeable.

Description of female paratypes

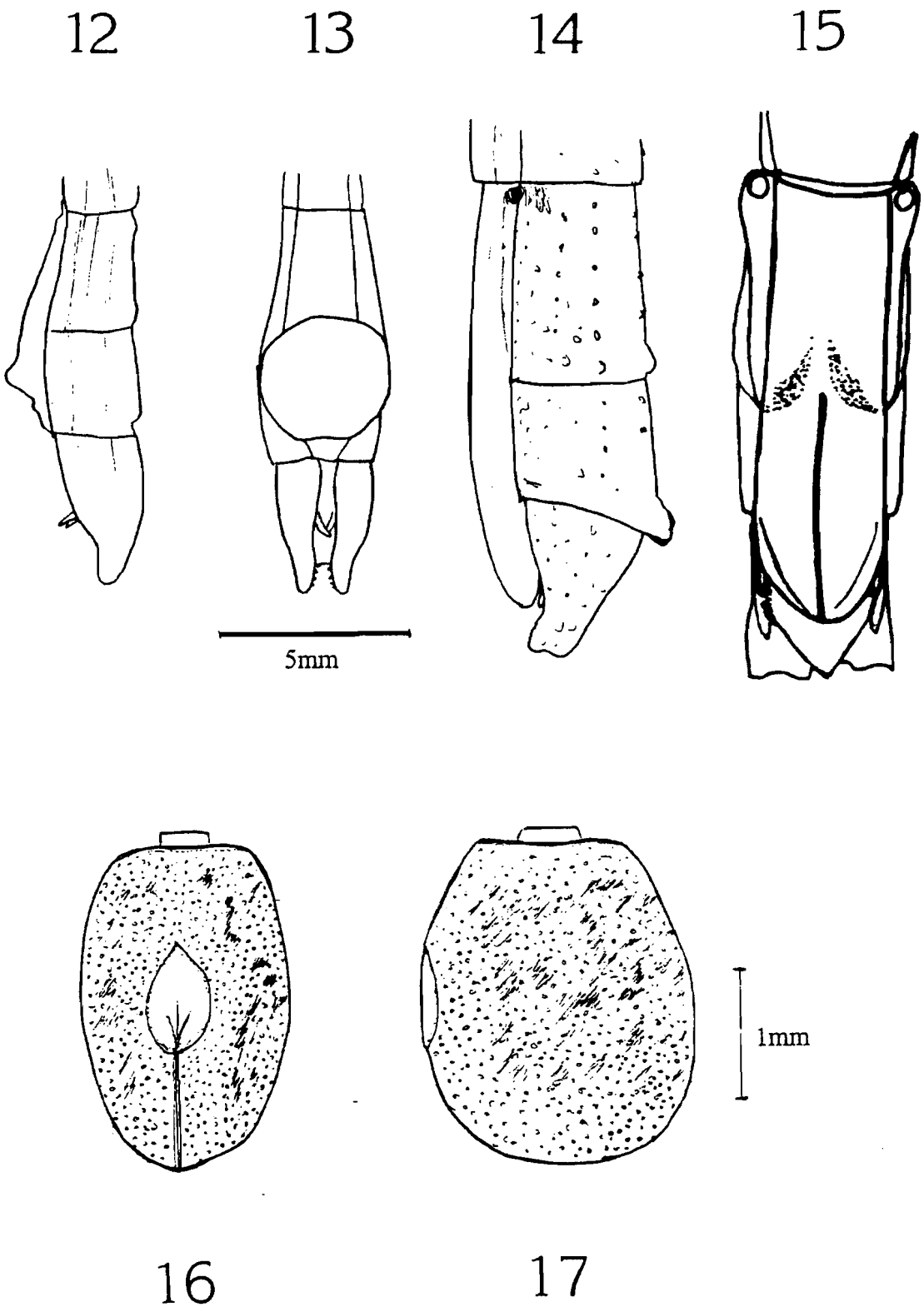
Variable shades of brown; legs sometimes mottled, with interrupted basal black band on mid and hind femora.

Head thick, slightly longer than wide, armed between the eyes with two bold spines on raised ridge, spines projecting outwards. Many tubercles and granulations present, but reared specimens often lack these. Back of head with median tubercles. Eyes small. Antennae short, less than half the length of the fore femora, with 21-22 segments. First two segments considerably broadened, but elongate; first segment particularly long (3mm); apical segments very shortened.

Pronotum slightly shorter than head with bold central cross-like depression and usually coarsely granulated (but not in some specimens). Deep median fissure on hind part of pronotum. Mesonotum and metanotum wrinkled longitudinally; ranging from having few tubercles to heavily tuberculate, particularly laterally. Mesonotum more than four times the length of the pronotum, widening gradually posteriorly. Metanotum about half the length of the mesonotum. Median segment short, slightly more than one quarter of the length of the metanotum. Underside of thorax smooth, or sparsely granulated in specimens which are heavily tuberculate dorsally.

Abdomen with small tubercles or granulations frequent (but almost absent in some specimens). Abdominal segments 8 and 9 slightly shorter in length; anal segment same length as 9th and tip slightly and unevenly triangularly incised in centre. Laterally, hind part of anal segment with small spine on each side, projecting backwards (also sometimes present on hind part of 8th segment). End of 9th segment with large twin tubercles in centre. When viewed laterally, the anal segment tapers sharply towards the tip. Operculum long, rounded at the tip which almost reaches end of anal segment. Cerci short, hidden beneath anal segment; tips of cerci rounded.

Legs elongate, slightly hairy; all femora with pair of apical spines. Fore femora slightly serrated up to middle of the upper crest. Mid femora with three large dentate foliaceous lobes dorsally and three small spines on the central carina (much reduced in some specimens). The hind femora have some small dorsal spines. The mid tibiae have two smaller foliaceous lobes at the proximal end and other minor spines. Slight dentation also on other femora (including 1-2 subapical spines) and tibiae; dentation variable, although usually with very minor dentation, in extreme cases this is absent.



Figures 12-17. *Medaura jobrensis* **n.sp. 12-13.** End of holotype male's abdomen, lateral & ventral; **14-15.** End of female abdomen, lateral & ventral; **16-17.** Egg, dorsal & lateral.

Description of egg

Various shades of brown, with darker brown patches, some joined together. Capsule almost oval; dotted with numerous darker brown pits. Micropylar plate centrally positioned; almost heart shaped; mid-brown, with darker outer rim. Plate joined by long median line. Capitulum of modest size, dark brown, with base and top black. Operculum black, with uneven and incomplete inner brown ring. Measurements: length 2.5mm, width 1.7mm, height 2.1mm.

Table 2. Measurements of *Medaura jobrensis* **n.sp.** (mm)

Lengths (mm)	Holotype ♂	paratype ♂♂	paratype ♀♀
Body length	73	71	90-106 ($\bar{x}$ 99)
Head	3.8	3.5	6-7
Antennae	17	17-18	11.5-16
Pronotum	3.5	3	5-5.5
Mesonotum	16	15	18-22
Metanotum	8	9	9-11
Median segment	2	2	3-3.5
Fore femora	33	33-35	32-42
Mid femora	21	21-22	21-27
Hind femora	30	30	28-37
Fore tibiae	34	34-36	35-43
Mid tibiae	22	21-22	21-27
Hind tibiae	32	31-33	30-41
Cerci	0.8	0.8	1.2

Distribution

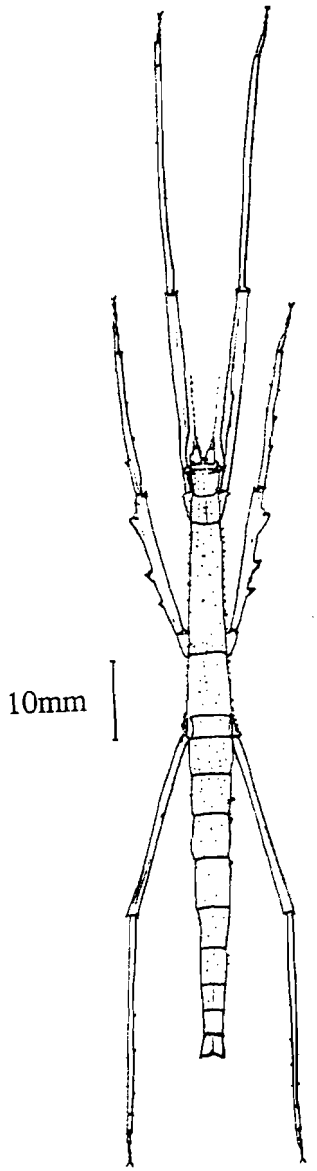
Collected in the daytime only from the type locality: University of Chittagong grounds, Jobra, Chittagong region, Bangladesh, so the status in the wild is unknown.

Etymology

Named after the type locality, Jobra.

Notes

i) Foodplants. In the wild foodplants include *Microcos paniculata* (Tiliaceae), *Streblus asper* (Moraceae) and *Litsea monopetala* (Lauraceae), amongst other as yet unidentified plants; this species is often found at rest on low growing vegetation. In captivity in Europe mainly fed on *Rubus fruticosus* (Rosaceae), widely used as a substitute foodplant for phasmids. However, they readily accept *Psidium guajava* (Myrtaceae), *Mangifera* sp. (Anacardiaceae), *Artocarpus heterophyllus* (Moraceae) and *Ficus religiosa*



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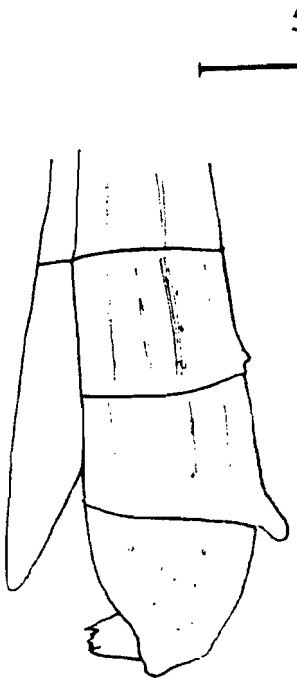

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Figures 18-20. *Medaura* sp. female from Lawachora, Sylhet. **18.** Dorsal view; **19.** End of abdomen, lateral view, **20.** ventral view.

(Moraceae).

ii) Behaviour. In defence, they appear to rely on remaining motionless, although nymphs sometimes curl their abdomens in a scorpion-like manner, even when at rest.

iii) Colour variation. Wild-caught material have more tubercles on the thorax and abdomen than the majority of reared specimens. Variably coloured nymphs and adults have been found or reared; females are particularly variable and larger nymphs have been found ranging from grey, brown, black, or combinations of these colours. Blotches often fit in well with their surroundings, hence dark insects with paler blotches.

iv) This species is currently being reared within the Phasmid Study Group as culture 202.

Other specimens

A smaller 77mm female (figures 18-20) of what may be a dwarf female form of *M. jobrensis* has been found at Lawachora, Sylhet region, 29.viii.1998, leg. N. Cliquennois (NHMW). Until other material is known and further eggs examined (there was damage to the eggs seen, which are similar to *jobrensis*), this specimen is left as doubtful and not part of the type series. Males (72mm) from Lawachora were observed, but not collected.

General discussion

Once again, variability in a phasmid species has confused authors, resulting in repeated descriptions. Variation is minimal in some phasmids, but extreme in others. However, in defence of early authors, this is not always straightforward to visualise, without the benefit of rearing a series of insects. There are, of course, many other problems with phasmid taxonomy, which are summarised in Brock (1998).

Acknowledgements

The authors wish to thank curators of the various museums visited for allowing access to collections, particularly Dr Ulrike Aspöck (NHMW). The following individuals kindly identified certain foodplants: Khairul Alam (Bangladesh Forest Research Institute, Chittagong); M. Salar Khan, Manzur-ul Kadir Mia (Bangladesh National Herbarium, Dhoka). Whilst in Bangladesh, Nahreen Farzana Shurobhi helped in several ways, including looking after live phasmids. Kristien Seru-Rabaey (Veurne, Belgium) lavished unfailing care on Bangladeshi livestock.

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First records and discovery of two new species of *Anisomorpha* Gray (Phasmida: Pseudophasmatidae) in Haiti and Dominican Republic

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Abstract
The genus *Anisomorpha* is recorded from the island of Hispaniola for the first time.

Key words
Phasmida, *Anisomorpha*, Haiti, Dominican Republic, first records.

Members of the genus *Anisomorpha* Gray are easily recognisable stick insects characterised by a stout cylindrical body, dark coloration and the ability to spray a toxic defensive chemical. They are exclusively found in the Neotropical region and known in the West Indies area from some islands of the Bahamas, Cuba, Jamaica, and Puerto Rico. Some *Anisomorpha*, e.g. *A. monstrosa* Hebard and *A. buprestoides* (Stoll), are relatively well known and can be found in culture. Although a total of 18 species are contained in the genus, apparently the richness of this group is even greater.

The stick insect fauna of Hispaniola (Dominican Republic and Haiti) is only minimally known as only 12 species have been reported from the island, most during the 18th and 19th centuries (see Langlois & Lelong, 1996, for a list of species). For the past few years, I have collected diverse phasmids throughout the Dominican Republic. Because of the very high level of endemism characterising the stick insects in the archipelago, the probability of discovering previously undescribed species is also high.

Moxey's (1972) unpublished doctoral dissertation contains the only record of *Anisomorpha* on Hispaniola. This work includes the description of a new species from some specimens collected in southern Haiti, but this was never published. This note has the purpose of reporting for the first time the presence of *Anisomorpha* on Hispaniola.

During a visit in the spring of 1999, I collected a large series of orthopteroids within epiphytic bromeliads in the mountains of Sierra de Bahoruco, southwestern Dominican Republic. A total of 15 males and three females were collected from an aggregation of around 25 individuals found piled up inside a group of bromeliads. In capturing the phasmids, many of them ejected appreciable amounts of their milky defensive secretions onto my hands. Most males were subadults, suggesting that they probably originated from the same brood. The insects were killed with cyanide, preserved in layers of napkins and later pinned.

In addition to the 18 specimens collected by myself, I have obtained on loan eight other specimens of *Anisomorpha* collected at Parc La Visite, Massif de la Selle, Haiti, property of the Florida State Collection of Arthropods, Gainesville, Florida, and 33 specimens collected at several localities north-east of Los Arroyos, Pedernales Province, property of the Carnegie Museum of Natural History, Pittsburgh, Pennsylvania. All the above localities are in the eastern portion of the mountain range that runs along the Southern Peninsula of Haiti, an area which was a separate island in the geological past and that is faunistically different from the rest of Hispaniola. *Anisomorpha* appears confined to this portion of the island, not being found in its central and northern portions.

Preliminary examination of these materials reveals that it involves two different and previously unknown species, one represented by the Haitian specimens from La Visite and the other by the Dominican specimens from Puerto Escondido and north-east of Los Arroyos. Important differences between the species are size, coloration, and shape of the female operculum. The description of these two new species of *Anisomorpha* is in preparation.

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Species report on *Pharnacia biceps* Redtenbacher, PSG 203

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Abstract

Brief descriptions of the adults, eggs and nymphs of *Pharnacia biceps* Redtenbacher (PSG 203) are given. Housing, feeding and breeding of this large species are discussed. This article previously appeared in *Phasma*, (9)36: 101-104, November 1999 (in Dutch).

Key words

Phasmida, *Pharnacia biceps*, rearing, Java.

Culture origin

Some years ago Johan van Gorkom found this species in the mountain forests of Eastern Java. He managed to breed them in captivity, but he was able to distribute any surplus only after several generations. In December 1997 he gave me a few small nymphs, from which I raised two females and one male to adulthood. I have since bred three further generations and have given away eggs, nymphs and adults to about a dozen other breeders. Recently, this species has been added to the Phasmid Study Group's culture list as PSG 203.

Taxonomy

Pharnacia biceps, belonging to the subfamily *Phasmatinae*, was first described in 1908 by professor J. Redtenbacher in the book "Die Insektenfamilie der Phasmiden" which he wrote together with K. Brunner von Wattenwyl. This species is similar to *Pharnacia westwoodii* (Wood-Mason), PSG 197, but differs by much less developed lobes on the seventh abdominal segment. The eggs are also clearly different.

Adults (Figures 1 & 2)

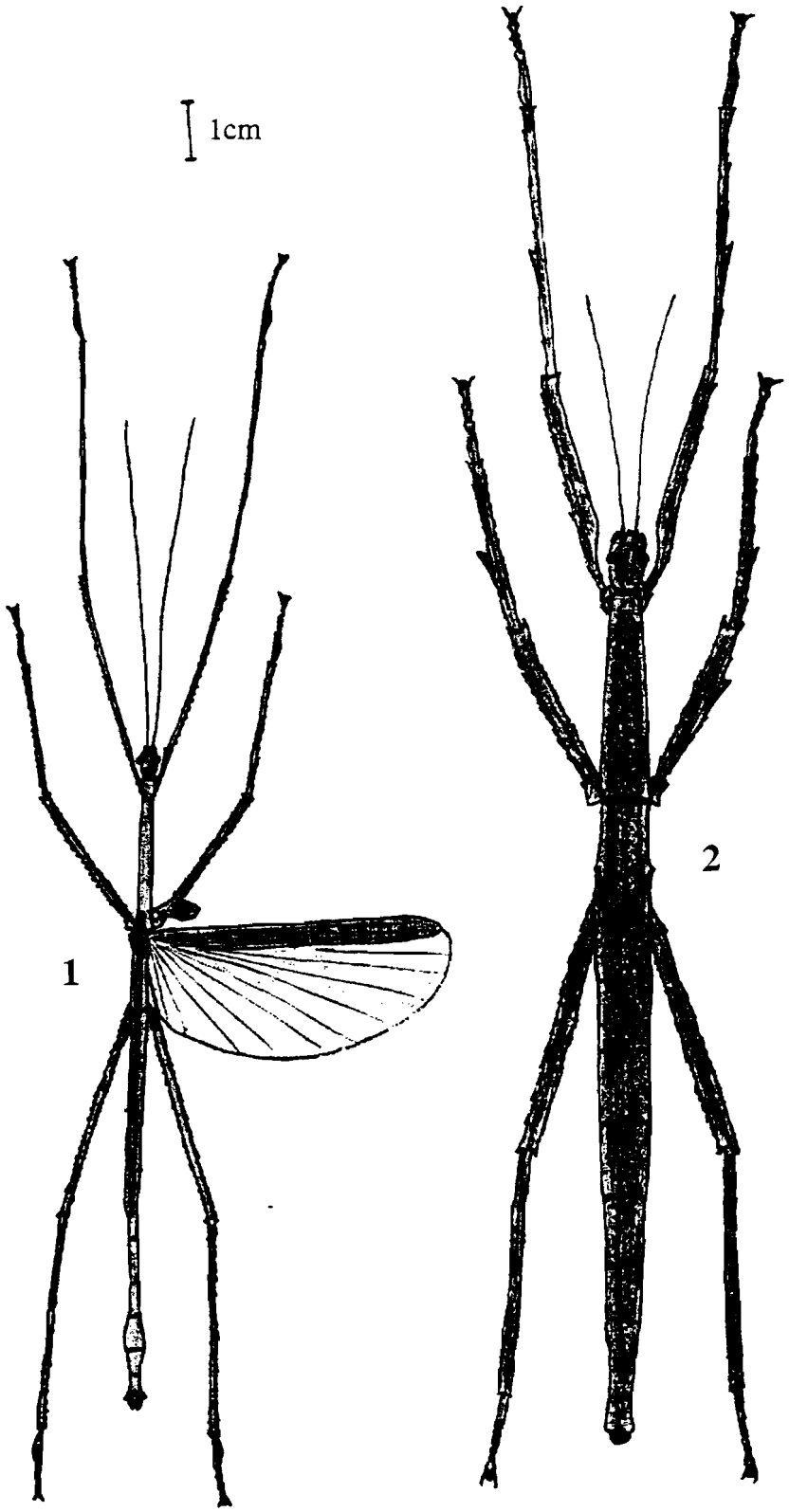
The female is brown, sometimes with a greenish sheen, and her body measures 160-180mm. The head is ovoid, with two small tubercles on the top. The antennae reach about 15mm beyond the joint between the front femur and tibia. All legs carry plenty of small teeth which always point towards the tarsi. Usually, the front and middle tibia have a bigger tooth at about one third from the knee joint, sometimes split into two points. In some females these are not present, or sometimes on only two or three legs. Sometimes the middle femur also has a similarly enlarged tooth. On the first tarsal segment of the front legs there is a very small lobe.

The tenth abdominal segment is slightly split into two lobes at the end. The subgenital plate has a rounded end and reaches a few millimetres further than this last segment. The cerci are very small. The abdomens of fat females can be up to 12mm wide.

The metanotum of the female has two small bumps at the place where winged species carry their hind wings. As the males of *P. biceps* are winged, these bumps may logically be the remains of wings that are degenerated during evolution. These small protuberances are also seen in other species of the genus *Pharnacia*.

The male has a body length of 105-120mm and is a lot slenderer than the female. He is brownish green in colour and has fairly large wings. With these wings he can flit about like a plump butterfly, although he rarely does so. The hind wings are green at the costal margin, the rest of the costal region is brown. The membranous part of the wing is light grey with tiny dark veins. The small front wings or elytra are brown and have a green stripe on the outer side.

The male's head is the same shape of the female's, but is a little slenderer. His antennae reach further than the middle of the front tibia. The legs are dark brown, they are also richly provided with very small teeth. When touched, the legs feel very rough: pay



Pharnacia biceps, **1.** Male. **2.** Female.

attention to this when handling an adult male, as the legs might stick onto your fingers and the insect can feel threatened enough to throw off a leg (autotomy).

The subgenital plate of the male is very thickened. The last abdominal segment is split into two parts up to about halfway. His cerci measure about 3mm and are slightly curved.

Dead specimens of *P. biceps* in a museum are usually a few centimetres longer than those we breed in captivity. These specimens are wild caught. Most species become smaller in captivity and their defensive behaviour becomes less obvious. The food also has an influence to the length of these insects (see feeding, below).

Adult females live for about half a year. The males regularly copulate and often a spermatophore can be clearly seen during or shortly after mating. This round spermatophore measures about 3mm. Due to their active life, the males usually die after only three or four months. Males that are isolated in a separate cage, easily live for a month longer. The females lay a nice number of eggs, 2 to 3 every day. Egg laying only starts three weeks after the female's final skin shedding. They catapult the eggs with a short but powerful swing with their abdomen. In an open environment the eggs would get at least 4 metres away from the female. A terrarium is a lot smaller than that so you regularly hear the eggs bouncing against the sides of the cage.

Eggs (Figure 3)

The eggs of *P. biceps* are smooth and oval shaped. They are about 4mm long, 3mm wide and 3.5mm high. The operculum carries a pistil-shaped capitulum consisting of a softer organic matter. The egg capsule itself is very hard, shiny, and dark grey in colour. Around the light grey micropylar plate there is a black border and around that another light grey border, forming a nice and clearly visible edge.

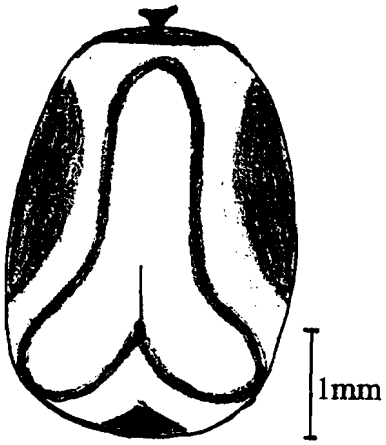


Figure 3. Egg, dorsal view.

The eggs are best incubated on a layer of slightly humid substrate. I personally prefer using soil which I firmly push to a hard layer of about an inch thick into a plastic incubating box. At a normal room temperature the nymphs will start hatching after about four months. If the average temperature is higher than 25°C (77°F), the first nymphs can hatch after three months. Temperatures higher than 30°C (86°F) increase the risk to dry out and can cause a too fast embryo development so that the hatching nymphs are fairly weak and sensitive to changes. There will also be more males at a higher temperature.

Nymphs

When the nymphs emerge from their egg, they already measure about 25mm. They have long legs, typical for a *Pharnacia* species. The body is light brown to grey, the legs are dark brown and banded with grey. The nymphs need enough space during hatching in order to fully expand their body and legs. When they are disturbed during this by another nymph, or if the incubating box is too small, their body will remain short and wrinkled. If such a nymph can eat without problems, this usually causes no death and after the first skin shedding the body will be normally stretched.

Female nymphs moult seven times, males six times. After the second moult the banded legs mostly become plain brown. They keep this colour until adulthood, but the brown can be light or dark depending on the temperature and relative humidity. Females have a more

developed body and wider legs with small teeth while males are a bit slenderer and their legs are less dentated. One can clearly distinguish them from the third nymphal stadium onwards by the male's developing genital bump under the end of its abdomen. Female nymphs in particular have a small lobe at both sides of the seventh abdominal segment. However, these lobes disappear as they become adult.

Defensive behaviour

The first and most obvious defense is mimicry: this species looks like a twig in shape and colour. The animals usually hang onto leaves and branches at random and move only at night so that they are not seen. However, the females sometimes lay an egg during the day. Then they first gently start wobbling as if a light breeze is blowing. In one fluent movement they flick an egg away and after that they keep on wobbling for a while. To potential enemies it looks as if there was just a gentle wind blowing though the trees.

When handling large nymphs or adults, they can squeeze their middle legs together. This really scares you as at that moment the tables seem to be turned: who is holding who? It sometimes happens that they drop a leg (autotomy) to confuse the enemy even more. Meanwhile the stick insect can drop itself to the ground or run away. Regenerated legs are virtually as long as normal legs after several skin sheddings, but they are never as thick and dentated.

In order to escape from the disturber, this species sometimes lets itself fall. The intention is to disappear into the dense ground vegetation of the forest. One day I wanted to take an adult female out of the cage. That cage is about 2 metres above the floor and I always need a chair to reach it. But that day I did not grip it well enough and she dropped to the ground, about 2.5 metres deep. She fell flat onto the floor and the smack made her abdomen burst at the right hand side. The tear was not a protruding wound, however, a few droplets of fluid came out. I carefully put her back into the cage. The sticky fluid dried out and that way the wound was actually closed after a couple of hours. She lived for about as long as the other females and laid a normal quantity of eggs. After a few days the wound was hard to see, but I believe she was very lucky to survive that accident.

Like many (if not all) phasmids this species can vomit some fluid. This liquid is the sticky stomach contents, which have a bad taste and smell. During vomiting they bend their head forward, meaning to dirty the enemy. If a predatory bird cleans its feathers after dinner, it will certainly remember what it has eaten.

Finally, adult males can fly away when disturbed. The wings are not strong enough to take it far away, but the insect can however escape in a flitting glide. Nymphs and adult females sometimes run away. This way of escaping is not that effective as it makes them very visible and usually the enemy is faster. However, when they can run away and suddenly go hanging under a large leaf, they might have more luck.

Feeding

We do not know what this species eats in nature. In captivity it likes bramble and I noticed that they really adore oak. In most European countries this is not available during winter, so always add bramble so that you can easily switch back onto bramble in winter. The adults that are raised on a mixture of bramble and oak appear to be larger and stronger than specimens that are raised on bramble only!

Other plants that are accepted as food are rose, hornbeam and hazel. There certainly are more, but I have only tried a few plants so far. They do not eat ivy.

If you get the choice, feed hard and strong leaves. They prefer this rather than soft, young and bright green leaves, which mostly contain too much water. From the latter they

can get diarrhoea and become ill. When you cannot find any dark, strong leaves (e.g. in April or May), you must seriously decrease spraying.

Care, housing and breeding

This fairly big species logically needs a spacious cage. Adults or large nymphs are best housed in a cage with a height of at least 750mm. Make sure the cage is well ventilated, for example with one whole side of netting. However, nymphs in the first and second instar can have a less ventilated cage because they like some more ambient humidity.

At my place this species is housed in a full glass terrarium with a wide strip of netting at the front near the bottom of the cage and the whole upper side is netting. On top of the cage I installed a tube lamp of 15W which works from 0900 to 2100. Every evening I spray with clean rain water in the cage (not too much!). This way the relative humidity inside the cage is higher at night (*c.* 80%). When the tube lamp is switched on the next morning, it gets a little warmer and the relative humidity decreases to about 60%. Animals that are constantly kept in humid conditions become very weak and often die before reaching adulthood.

The temperature should not be too high. During the day it is a bit warmer due to the rays of the tube lamp on top of the cage, but the temperature usually does not get higher than 25°C. At night the temperature usually decreases to about 20°C. In winter it may sometimes, on the coldest nights, even be as low as 18°C.

When given the right conditions, this species is not difficult to breed.

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How *Anisomorpha* got its stripes?

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Abstract

The significance of the colour pattern in the phasmid genus *Anisomorpha* is discussed in relation to recent hypotheses on the evolution of density dependant aposematism in the desert locust. The biology of *Anisomorpha* species offers several alternative explanations of coloration in these species, such as true aposematism, regarding defensive spray; aposematism as the result of feeding behaviour; and density dependant aposematism.

Key words

Phasmida, Aposematism, *Anisomorpha*, *Schistocerca,* Evolution, Density-dependence, mate protection.

This short communications was prompted by a review article of a similar name (Wilson, 2000) regarding aposematic coloration in the Desert Locust (*Schistocerca gregaria*). Wilson described the work of Sword *et al.* (1999 & 2000), regarding the density morphs of *Schistocerca*. The nymphal stages of *S. gregaria* occur in two morphs; a high-density morph characterized conspicuous yellow and black stripes, and a cryptic green morph at low densities. The well-documented swarming behaviour of *Schistocerca* has long interested biologists due to the economic implications of swarms. The advantage to the high-density phenotype is the yellow and black markings displayed by the nymphs, the function of which has so far remained a mystery. Wilson postulates that they function as a visual signal to aid nymphal aggregation or they function with a thermoregulatory role, or as an aposematic (warning) signal. However, we know that locust nymphs are frequently consumed by many species and there are field observations also documenting predation on high-density dependant phenotypes (Gillet & Gonta, 1978).

Sword (1999), demonstrated that the high-density dependent phenotype in *Schistocerca* could act as a potential warning signal to predators, indicating that nymphs have been feeding on toxic food plants, via a series of experiments using lizards and palatable (non-toxic foodplant-fed) and unpalatable (toxic foodplant-fed), low and high density phenotype locust nymphs. In a subsequent study (Sword *et al.*, 2000) demonstrated that predators could learn from one feeding event, that a nymph of the high-density dependant phenotype is unpalatable, yet the low-density (green) phenotype did not elicit such a response. This indicates that the coloration impacts on the predator resulting in avoidance of the high-density phenotype.

Density dependant colour change has evolved in Lepidoptera and has even been documented in phasmids (Key, 1957). This prompted me to consider the coloration and biology of the phasmid *Anisomorpha buprestoides* (Stoll) (and the related striped species, *A. monstrosa* Hebard, and *A. ferruginea* (Beauvois)). *Anisomorpha buprestoides* is a small species of phasmid from North America, which possesses two longitudinal, contrasting stripes (usually white or pale brown on a dark brown or black background). This prompted the following questions: Have these striped *Anisomorpha* species developed aposematic coloration as a warning of the defensive spray? Is this a warning of potential toxic food plant consumption? Alternatively, is it a result of density dependence?

The ability to produce a defensive spray, effective up to 30 cm away, is obviously a good deterrent against predators. However if an insect with a good defensive ability was not conspicuous to predators the defense is of little use (Sword *et al.*, 2000). The warning coloration/pattern is essential to predator recognition. The selective advantage provided by an obvious pattern and a defense mechanism would allow the genes for this to spread throughout the population.

Did *Anisomorpha* develop the aposematic coloration in response to the consumption of predator toxic food plants, and the defensive spray evolve subsequently? Sword *et al.* (1999 & 2000) have demonstrated that *Schistocerca* congregate on predator toxic food plants in

preference to more palatable host plants. The evolutionary sequence of events is unknown, therefore the validity of this hypothesis cannot be assessed. However, insects sporting aposematic coloration and not being toxic are more likely to be found out by predators, therefore non-toxic individuals are likely to be cryptic at low density. This is observed in locusts and certain Lepidoptera (Reeson *et al.*, 1998). It should also be noted that many species of phasmid produce defensive sprays, yet remain cryptic.

Finally, the evolution of density dependant aposematism in stable populations, where the supply of toxic host-foodplants is predictable, would only occur at high population levels (Wilson, 2000). The observation of other aspects of *Anisomorpha* biology would seem to indicate that this group favours high densities of conspecifics. *Anisomorpha* species, especially the nymphal stages, are gregarious. These taxa exhibit social interactions and antagonistic behaviour, such as abdomen tapping in response to conspecifics. In addition, the males of this species mate for extended periods (sometimes throughout life), which would indicate mate protection is occurring. This would be of benefit in high densities (protection) and at low densities (mate finding restrictions), however the gregarious behaviour of *Anisomorpha* is not consistent with the low-density hypothesis.

This short paper has posed more questions than it has answered regarding the evolution and behaviour of this fascinating group of phasmids, hopefully it has stimulated some thought on the subject. It would be interesting to hear any other thoughts on the significance of coloration in a group of insects renowned for their cryptic behaviour.

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Reviews and Abstracts.

Book Reviews

Nanafushi-No-Subete (All About Japanese Stick-Insects) by Masaya Okada (1999). Published by Tonbo-Shuppan Publishing, Karahori-Cho 8-16, Tennôji-ku, Osaka, 543-0012, Japan. Paperback with card flycover, 56 pages (text in Japanese) with numerous black-and-white and colour plates and several line drawings, 26cm x 18cm. Price ¥1,800 + tax. ISBN 4-88716-114-X. **Reviewed by Paul D. Brock.**

This book is a useful guide by an amateur enthusiast to 18 species of stick-insects found in Japan. The author is to be congratulated on a well laid out guide, which should encourage interest in the fauna. I cannot comment on the text, which is in Japanese. A photocopy of the species list on page 55 (half identified only to genus level) would help when going through the captions to photographs. Measurements of adults are given, based on body length and including outstretched legs.

It is the luck of the draw whether photographs for particular species are in colour (every second set of pages) or in black and white. Unfortunately this means that arguably the most attractive species *Megacrania tsudai* is only shown in black and white. However, even non-colour reproductions are suitable to assist in identification, as the author has often included photographs (or occasionally figures) of genitalia. Other useful features are photographs showing the habitats of some of these species, moulting in winged and wingless insects and the eggs of 13 species. Figures include a rearing container and setting specimens.

The classification used is the main issue with this book. There are various interesting papers on the Japanese fauna, which are not mentioned in this book; in 1935 Shiraki covered the fauna (at least 23 species) in some detail. The author informs me that he found it difficult to place insects to species level from Shiraki's paper. However, a checklist of species given in Shiraki would have been useful although most of the genera Shiraki discussed are covered. Until further research is undertaken there are, of course, doubts whether all valid Japanese species are featured in this new book (it must be pointed out that Shiraki described some likely synonymous species on the basis of minor variation). Good illustrations of *Pylaemenes mouhotii* (listed as *Datames mouhoti*, which should be spelt *mouhotii*) indicate that the Japanese insects have been misidentified in the past and are distinct from, but more closely allied to, *P. oileus* (Westwood) rather than *P. mouhotii* (type locality Cambodia).

Despite the shortcomings mentioned above, serious phasmid enthusiasts and taxonomists will want to obtain a copy of this reasonably priced book. Of the species discussed only *Sipyloidea sipylus* is well known to breeders, and now that the author has become our first member from Japan it is hoped that at least one or two species will be widely reared by PSG members in future.

Wandelende takken als hobby by Wim Potvin (2000 or 1999?). Privately published, available from the author: Brusselbaan 7, 1600 Sint-Pieters-Leeuw, Belgium. Softback, A4, 58 pages. Price 10E. **The following information was provided by the author.**

A basic information book on rearing phasmids, written in Dutch. Half the book deals with general information on diversity, defensive behaviour, reproduction, housing, feeding etc. The second half of the book is composed of single page reports on 31 commonly reared species, with notes on related species.

Die Struktur der Eihüllen von 48 Phasmatodea-Arten aus der Sammlung des Löbbecke Museum und Aquazoo Düsseldorf. The structure of the egg chorion of 48 Phasmatodea species from the collection of the Löbbecke Museum and Aquazoo Düsseldorf by Klaus Lipinski, Hartmut Greven, Dieter Schulten and Siegfried Löser (1999). Published by Entomologische Mitteilungen aud dem Löbbecke-Museum and Aquazoo, D-40200 Düsseldorf, Germany. Paperback, A5, 125 pages, 3 tables, 49 black and white plates. Price 40DM. **Reviewed by Paul D. Brock.**

This is a companion volume to Schulten's book on breeding phasmids *Wandelnde Blätter, Stab- und Gespenstschrecken* (1995), in the same yellow cover design showing a female *Extatosoma tiaratum*, with the addition of two eggs. However, as this book only covers scanning electron microscope studies (some for the first time), it will have a much more limited appeal.

There has been a noticeable increase in interest in the study of phasmid eggs recently, including the release of a CD-ROM by two other enthusiasts from Germany, which covers 180 species. The work reviewed features the eggs of 48 species, with text in German (with an English summary). After giving classification tables [including errors in spelling for families and species, such as *P. serratipes* which is incorreclty referred to as *P. acanthopus* on page 6 while the species name, but not genus, is correct on p. 80)], each species is covered by a page of text alongside a one page plate, with 5-10 reasonable quality photographs of key parts of eggs. Unfortunately, the country of origin of culture, or other stock, is not mentioned, except for some of the undescribed species which are included. Nevertheless, most PSG members would be able to work this out from the culture list or by reference to Schulten (1995).

The short bibliography includes some of the key references on phasmid eggs. However, it omits Clark Sellick's important 1998 paper "The micropylar plate of the eggs of Phasmida, with a survey of the range of plate form within the order" *Systematic Entomology* **23**: 203-228, amongst others. Whilst this book is useful for phasmid enthusiasts seriously interested in studying eggs, there is little excuse for numerous errors in the names of species. These could easily have been avoided by taking note of errors pointed out in reviews of Schulten's book [mainly repeated here], or by taking the trouble to send the manuscript for checking by one of a number of phasmid specialists. Nevertheless, this is the first publication of its type on phasmid eggs and one of 17 in-print books on phasmids (15 published in the 1990s). It highlights taxonomic problems in some well known genera (which will hopefully be worked on by taxonomists in the near future). The errors in the main species covered are listed below, quoting page references:

14 *Diapheromera femorata* (Say, 1824) - not 1828.

16 *Oreophoetes peruana* - not *peruanas*.
Bacteria rarospinosa (Brunner, 1907) - not *Dyme*.

22 *Carausius alluaudi* (Bolivar, 1895) - not Bolivar, 1895.
Carausius morosus (Sinéty, 1901) - not Brunner, 1907.

32 *Lonchodes modestus* (Brunner, 1907) - not Brunner, 1907.
Lonchodes strumosus (Brunner, 1907) - not Brunner, 1907.

36 *Lonchodes brevipes* Gray, 1835 - not *L. uniformis* Westwood, 1848.
Lopaphus muticus (Redtenbacher, 1908) [if it is this species] - not *Candaules muticus* Redtenbacher, 1908.

42 *Paramenexenus laetus* (Kirby, 1904) - not *P. operculatus* Redtenbacher, 1908.
Lopaphus perakensis (Redtenbacher, 1908) - not *Paramyronides*.
Gratidia sp. - not *Ramulus*.

56 *Gratidia* sp. - not *Ramulus*.
Hesperophasma lobata (Redtenbacher, 1908) - not Redtenbacher, 1908.
Phobaeticus serratipes (Gray, 1835) [or *Baculolonga* Hennemann & Conle, 1998 if one agrees with this genus] - not *Pharnacia*.

82 *Acrophylla wuelfingi* - not *wülfingi*.
Eurycnema versirubra (Serville, 1838) - not *E. herculeana* (Charpentier, 1845).

86 *Rhaphiderus scabrosus* (Percheron, 1844) - not 1829-44.
Extatosoma tiaratum (Macleay, 1826) - not Mac Leay, 1826.

90 *Bacillus rossius* (Rossi, 1790) - not *rossii* (Fabricius, 1793).

92 *Dares verrucosus* Redtenbacher, 1906 - not *D. breitensteini* Westwood, 1859 [in any case, described by Redtenbacher, 1906]

L'Elevage des Phasmes by Christophe Bauduin & Arnaud Bauduin (2000). Published by Philippe Gérard Editions, Paris. Paperback, A5, 82 pages, 38 colour photographs, plus two on the cover. Price 80F. ISBN 2 912521 21 1. **Reviewed by P.E. Bragg.**

This French book on rearing phasmids follows the usual pattern for books on this subject. The introductory chapters discuss the problem of name changes, the different forms of phasmids, the choice of species to keep, rearing conditions, reproduction, and biology. The bulk of the book is devoted to details of thirty-eight species: a brief description of adults, young and eggs, conditions for rearing, comments on the reproduction, and some general comments. A good selection of the more popular species are included, at the same time representatives of most of the available subfamilies are covered. A short glossary is included at the back of the book. This book will be of great value to the French-speaking phasmid rearer. The 14 pages of colour illustrations will be particularly helpful to those unfamiliar with the species.

The Amazing World of Stick and Leaf-Insects by Paul D. Brock (1999). Published as *The Amateur Entomologist* volume 26 by Amateur Entomologists' Society, Orpington, England. A5 format, hardback, 165 pages, including 40 colour & 26 monochrome plates, 45 drawings. Price £14.75. ISBN 0 900054 63 8. **Reviewed by P.E. Bragg.**

This book gives a well illustrated overview of the phasmids of the world. The text is divided into three main sections. The first section follows the general pattern of introductory books on stick insects, covering the basic biology and behaviour; there are also numerous examples of phasmid trivia which will be of interest to many people, examples include: longest and shortest species, heaviest, longest life-span, and the most dangerous. The second section covers collecting, rearing and preserving specimens. This section also gives details of many of the important public museum collections of phasmids in the world, with a useful list of published catalogues to these collections. The third, and largest, section deals briefly with each of the major biogeographical regions of the world, looking at various species which are found in these areas.

The large number of illustrations in this book is very pleasing, it is unfortunate that the reproduction of the monochrome illustrations is of poor quality. The 40 colour plates are made up of 87 photographs of a wide variety of species, the publisher has produced these at a much better quality than the monochrome illustrations. The monochrome illustrations are from a variety of sources, many are reproductions of drawings from publications by other authors, during the past 150 years; the sources, and information to supplement the captions for all illustrations are listed at the front of the book.

This book is a *must* for anyone interested in phasmids and will be particularly useful to anyone interested in expanding their knowledge beyond the rearing of phasmids.

Forthcoming books

Phasmids of Borneo by P.E. Bragg. Published by Natural History Publications (Borneo), Kota Kinabalu, Sabah. Hardback, approximately 750 pages, over 700 illustrations, many distribution maps. Describing a new family, several new genera and numerous new species. Provisional publication date 18th March 2001. ISBN 983 812 027 8.

Phasmid Abstracts

The following abstracts briefly summarise articles which have recently appeared in other publications. Some of these may be available from local libraries. Others will be available in university or college libraries, many of these libraries allow non-members to use their facilities for reference purposes free of charge.

The editor of *Phasmid Studies* would welcome recent abstracts from authors so that they may be included in forthcoming issues. In the case of publications specialising in phasmids, such as *Phasma*, only the longer papers are summarised.

Brock, P.D. (1998) Catalogue of type specimens of Stick- and Leaf-Insects in the Naturhistoriches Museum Wein (insecta: Phasmida). *Kataloge der wissenschaftlichen Sammlungen des Naturhistorischen Museums in Wein, 13, Entomologie*, 5: 1-79.

Type specimens of 784 taxa have been located in the Naturhistoriches Museum Wein [Vienna] (NHMW), which is the most important collection in the world for phasmid taxonomy. The species are listed alphabetically, with the number of specimens, sex and locality data which, excepting very few instances, have never been recorded before. The most important material related to species described by Brunner von Wattenwyl and Redtenbacher mainly published in their monograph between 1906-1908) and the majority of Stål's types. There are a number of discrepancies in the literature, relating to the whereabouts of type specimens, which are commented on; in particular, a number of specimens recorded from other museums are only present in NHMW and data labels invariably refer to the other museum(s) and, in some instances, are known to have been "loaned" especially for the monograph. Additionally, the known whereabouts of the remaining type series (where applicable) is recorded and, wherever possible, has been personally verified by reference to the collections concerned; Brunner exchanged some material without any reference being made in the literature. Comment is also made on the likely number of synonyms yet to be recorded. Lectotypes are designated for the following species present in NHMW: *Marmessoidea conspersa* Redtenbcaher, 1908, a new synonym of *Trachythorax atrosignatus* (Brunner, 1893); *Eurycnema stenocerca* Redtenbacher, 1908 and *Abrosoma virescens* Redtenbacher, 1906. In addition, lectotypes are designated for specimens in MCSN (relating to species where paralectotypes are present in NHMW): *calvisia areuginosa* Redtenbacher, 1908; *Phaeophasma alatum* Redtenbacher, 1906; *Oreophasma exilis* (Brunner, 1907); *Autolyca flavolimbata* Redtenbacher, 1906; *Carausius granulatus* Brunner, 1893; *Paranecroscia longicollis* Redtenbacher, 1908; *Paraphasma marginale* Redtenbacher, 1908; *Dimorphodes miles* Redtenbacher, 1908; *Parapachymorpha nigra* Brunner, 1893; *Neopromachus simulator* (Brunner, 1907); *Lonchodes spectatus* Brunner, 1907 and *Neopromachus vepres* (Brunner, 1907). *Acrophylla aliena Redtenbacher, 1908* is transferred from *Ctenomorphodes* Karny to the genus *Ctenomorpha* Gray. *Bacteria redtenbacheri* is given as a replacement name for *Bacteria innocens* Redtenbacher, 1908.

Brock, P.D. (1998) Studies on the stick-insect genus *Eurycnema* Audinet-Serville (Phasmida; Phasmatidae) with particular reference to Australian species. *Journal of Orthoptera Research*, 7: 61-70.

Two species of *Eurycnema* occuring in Australia are described and figured. Previously, various species were linked together in the literature and Australian specimens invariably listed as *Eurycnema goliath* (Gray, 1834). Brief notes on distribution, biology, and habitat are presented, in addition to keys to adults and eggs and the first descriptions of teh males of *E. osiris* (Gray, 1834) from Australia and *E. nigrospinosa* Redtenbacher, 1908 from Papua

New Guinea. Eggs of all four *Eurycnema* species are figured for comparison and published synonyms are corrected. Lectotypes have been designated for *E. goliath*, *E. viridissima* Kirby, 1904 (a synonym of *E. goliath*) and *E. cercata* Redtenbacher, 1902. *Eurycnema stenocerca* Redtenbacher, 1908 and *E. cercata* are listed as new synonyms of *E. osiris*, and *E. magnifica* Kirby, 1904 is a new synonym of *E. goliath*.

Brock, P.D. (1998) A study of stick-insects (Phasmida) from Kakadu National Park, Northern Territory, Australia. *Journal of Orthoptera Research*, **7**: 71-76.

Following a survey of the area, five species of stick insect are reported from Kakadu National Park, Northern Territory, Australia: *Sipyloidea filiformis* Redtenbacher, 1908, *Hyrtacus carinatus* (Sjöstedt, 1918), *Anchiale spinicollis* (Gray, 1833), *Arphax dolomedes* (Westwood, 1859) and *Eurycnema osiris* (Gray, 1834). A table showing the key features of adults and eggs is included, along with brief notes on habitat and drawings of adults and eggs.

Brock, P.D. (1999) Preserving fragile stick insects. *Metaleptea*, **19**(2): 8.

A short note recommending putting phasmids on card rather than in paper packets when collecting in the field.

Brock, P.D. (2000) Stick-insects (Phasmida) from the Cape Town area, South Africa. *Bulletin of the Amateur Entomologists' Society*, **59**(428): 2-12, pl. 00A, 00B, 00C & 00D.

Discusses the results of a collecting trip to the Cape Town area of South Africa on which three species were found. The eggs of all three are illustrated with line drawings and the adults are illustrated with colour plates: *Macynia labiata* (♂ & ♀), *Phalaces longiscaphus* (♂ & ♀) and *Carausius morosus* (♀). Brief descriptions and notes on rearing are given. Two new synonyms of *Macynia labiata* (Thunberg, 1784) are listed: *Bacillus capensis* Serville, 1838, and *Bacillus stellenboschus* Westwood, 1859.

Brock, P.D. & Seow-Choen, F. (2000) The stick insects (Insecta: Phasmida) of Hong Kong. *Serangga*, **5**(1): 113-147.

Stick insects of Hong Kong, especially from the Hong Kong Island, are represented by nine species, including five new to science. The new species are *Neohirasea hongkongensis*, *Sipyloidea peelensis*, *Entoria victoria*, *Baculum caii*, *Pylaemenes hongkongensis*. The new species are described and illustrated. *Dixippus cornutus* Kirby is reduced to a synonym of *Lonchodes stomphax* Westwood. Two keys to mlaes, and females, of all species are provided.

Calvitti, A. & Beer, R.D. (2000) Analysis of a distributed model of leg coordination: I. Individual coordination mechanisms. *Biological Cybernetics*, **82**(3): 197-206.

Using tools from discrete dynamical systems theory, we begin a systematic analysis of a distributed model of leg coordination with both biological and robotic applications. In this paper, we clarify the role of individual coordination mechanisms by studying a system of two leg oscillators coupled in one direction by each of the three major mechanisms that have been described for the stick insect *Carausius morosus*. For each mechanism, we derive analytical return maps, and analyze the behaviour of these return maps under iteration in order to determine the asymptotic phase relationship between the two legs. We also derive asymptotic relative phase densities for each mechanism and compare these densities to those obtained from numerical simulations of the model. Our analysis demonstrates that, although each of these mechanisms can individually compress a range of initial conditions into a narrow band of relative phase, this asymptotic relative phase relationship is, in general, only neutrally

stable. We also show that the nonlinear dependence of relative phase on walking speed along the body in the full hexapod model can be explained by our analysis. Finally, we provide detailed parameter charts of the range of behaviour that each mechanism can produce as coupling strength and walking speed are varied.

Chen S.C., Shang Z.H. & Pei H.C. (2000) Two new species of walking stick (Phasmatodea: Phasmatidae) from Xizang and Yunnan, China. *Entomotaxonomia*, **22**(2): 98-100. [In Chinese]

This paper describes two new species of the family Phasmatidae from Xizang and Yunnan, China. The types are kept in the Institute of Zoology, Academia Sinica. *Baculum nyalamense*, n.sp. is similar to *B. obnoxium* (Brunner), but differs from the latter by the large-sized, hind femora longer, and the shape of anal segment and operculum are also different; holotype female, Nyalam, 2300m, Xizang. *Paraclitumnus bannaensis*, n.sp. is closely related to *P. apicalis* (Chen & He), but differs from the latter in the head rather elongated and flat, four posterior femora with 6-7 small teeth on the apical portion of inferior median carina, apico-lateral lobes of anal segment sharp, the size and shape of supraanal plate and cerci are also different; holotype female, Xishuangbanna, 1200m, Yunnan.

D'Hulster, K. (2000) Incubatieduur van eitjes en de ontwikkelingstijd van nimf tot volwassen imago. *Phasma*, **10**(38): 38-39. [in Dutch].

Egg incubation and development (from hatching to adult) times are listed for 59 species of phasmids in captivity.

D'Hulster, K. (2000) Wandelende takken op school. *Phasma*, **10**(39): 57-69. [in Dutch].

Details activities and experiments using stick insects in schools. Includes several figures and tables.

Fritzsche, I. (1998) Phasmidensteckbrief Nr. 4. *Gratidia* spec. Zaire (PSG 141). *Arthropoda*, **6**(2): 14-16. [in German]

Describes rearing of *Gratidia* sp., PSG culture 141, from Zaire. The male, female and egg are all illustrated.

Harman, A. (2000) Behoud van de Phasmidensoorten in Kweek. *Phasma*, **10**(37): 9-18. [in Dutch]

The author gives advice and a proposal concerning conservation of the phasmid species in culture. He also gives information about species not on the PSG culture list, and on "lost" cultures that are again back in culture. Some advice on alternative and specialised foodplants is given.

Hennemann, F.H. (1999) On two species of Phasmatodea in the collection of the Institut royal des Sciences naturelles de Belgique, Bruxelles, including the description of a new species. *Bulletin de la Societe Royale Belge d'Entomologie*, **135**(7-12): 213-215.

One new species of Phasmatodea (*Nesiophasma zanuis* n.sp.) as well as the egg of *Phasma marosensis* Hennemann 1998 are described and illustrated. The specimens discussed are preserved in the collection of the Institut royal des Sciences naturelles de Belgique, Bruxelles.

Hennemann, F.H. & Conle, O.V. (1997) Beschreibung des Männchens und der Eier von *Phasma reinwardtii* de Haan 1842 (Phasmatodea: Phasmatinae). *Entomologische Zeitschrift*, **107**(7): 290-294. [in German]

The recently discovered male of *Phasma reinwardtii* de Haan, 1842 as well as the eggs of this species are described and illustrated for the first time. A key is given for the males, and illustrations show the differences between both sexes of *P. gigas* (Linnaeus, 1758) and *P. reinwardtii*.

Hennemann, F.H. & Conle, O.V. (1997) Zwei neue Stabschrecken von der Philippinen (Phasmatodea). *Entomologische Zeitschrift*, **107**(8): 343-351. [in German]

Two new species of Phasmatodea from the Philippine island of Mindoro are described and figured, including a description and illustration of the egg of *Manduria halconensis* n.sp. *Manduria halconensis* differs from the only other known member of the genus, *M. systropedon* (Westwood, 1859) by the body being stouter, the legs shorter with the mesofemora bearing leaf-like lobes, and the different structure of the body granulation.

The new genus *Baculolonga* is erected with *Cladoxerus serratipes* Gray, 1835 as the type species. The genus is easily distinguished from *Pharnacia* Stål, 1877 and *Phobaeticus* Brunner, 1907 by the morphology of the eggs. Additionally, it differs from *Pharnacia* by being more slender in both sexes and by the slightly longer median segment of the females and from *Phobaeticus* by the winged males (except *B. philippinica* n.sp.) and the much longer median segment. The egg of *B. serratipes* (Gray) is illustrated. *Baculolonga philippinica* is similar to the three other members of the new genus, *B. serratipes* (Gray, 1835), *B. kirbyi* (Brunner, 1907) and *B. redtenbacheri* (Dohrn, 1910), but can be easily distinguished from these by the males being completely wingless. The egg of the new species is still unknown, while the eggs of the other three species have previously been described by other authors.

Hennemann, F.H. & Conle, O.V. (1997) Eine Bemerkenswerte neue Reisenstabschrecke aus Vietnam: *Phobaeticus heusii* n.sp. (Phasmatodea: Phasmatidae: Phasmatinae. *Entomologische Zeitschrift*, **107**(12): 504-509. [in German]

Phobaeticus heusii n.sp. from Vietnam is described and illustrated, including the eggs. It is closest related to *Phobaeticus frustoferi* Brunner, 1907, but differs in being much larger and the males showing a different colouring. The eggs are quite similar to those of *Phobaeticus sichuanensis* Cai & Liu, 1993. The males are the largest male stick insects known so far, and the only two species in which the female has a longer body are *Baculolonga kirbyi* (Brunner, 1907) with a length of 328mm and *Nearchus maximus* Redtenbacher, 1908 with a length of 300mm.

Hennemann, F.H. & Conle, O.V. (1999) Typenmaterial der Phasmatodea im Naturhistorischen Museum Basel. *Entomologica Basiliensia*, **21**: 5-12. [in German]

A catalogue is provided for the type material of Phasmatodea (27 species and 9 subspecies) deposited in the Naturhistorischen Museum Basel, Switzerland (NHMB). All data for the material concerned are given along with taxonomic and relevant comments. *Leocrates mecheli* Redtenbacher, 1906 is listed as a new synonym of *Haaniella muelleri* (de Haan, 1842) as a long-winged form of the latter. *Calvisia coniceps* Redtenbacher, 1908 is listed as a new synonym of *Calvisia virbius* (Westwood). [Editor's note - type species are "designated" unnecessarily for *Brachyrhamphus* Carl, 1915 (established as a monotypic genus), and *Hemiplasta* Redtenbacher, 1908 (type species *Necroscia styligera* Bates, 1865, designated by Hennemann in 1998, *Mitt. Mus. Nat.kd. Berl., Zool. Reihe*, 74: 121).]

Hennemann, F.H. & Conle. O.V. (1999) *Ladakhomorpha longipes* gen.n., sp.n. - eine bemerkenswerte neue Phasmide aus Indien (Phasmatodea; Pachymorphinae). *Entomologica Basiliensia*, **21**: 13-17. [in German]

A new genus and species of Phasmatodea, *Ladakhomorpha longipes*, from Ladakh in northern India is described and illustrated. The genus resembles *Macynia* Stål and *Bacillus* Latrielle, 1825 but is most closely related to *Leptynia* Pantel, 1890.

Hennemann, F.H., Conle, O.V. & Seiler, C. (1998) Bemerkungen zu *Lopaphus caesius* (Redtenbacher 1908) nebst Beschreibung der Eier (Phasmatodea: Necrosciinae). *Entomologische Zeitschrift*, **108**(5): 197-203. [in German]

The egg of the phasmid *Lopaphus caesius* (Redtenbacher, 1908) from Vietnam is described and illustrated for the first time, and a redescription of both sexes is given. *Cercophyllia sphalera* Redtenbacher, 1908 proved to be a synonym of *Lopaphus caesius*, resulting in the synonymy of the monotypic genus *Cercophyllia* Redtenbacher, 1908 with *Lopaphus* Westwood, 1859. After close examination of about 2000 eggs it has been found that there are two different types of eggs which are both described and figured in this paper. Some notes on the biology and breeding of this species are included.

Kiew, R. & Seow-Choen, F. (2000) Stick-insects destroying orchids. *Gardenwise*, **14**: 24.

A brief review of Ridley's 1894 report of phasmids eating orchids in Singapore. With colour photograph of *Datames oileus*.

Lorenz, M.W., Kellner, R., Hoffmann, K.H. & Gaede, G. (2000) Identification of multiple peptides homologous to cockroach and cricket allatostatins in the stick insect *Carausius morosus*. *Insect Biochemistry and Molecular Biology*, **30**(8-9): 711-718.

Eighteen peptides were isolated from brain extracts of the stick insect *Carausius morosus*. The peptides were purified in four steps by high-performance liquid chromatography, monitored by their ability to inhibit juvenile hormone biosynthesis by corpora allata of the cricket *Gryllus bimaculatus* in vitro, and chemically characterised by Edman degradation and mass spectrometry. We obtained complete primary-structure information for nine peptides, four of which belong to the peptide family characterised by a common C-terminal pentapeptide sequence-YXFGLamide. The remaining five belong to the W2W9amide peptide family, nonapeptides characterised by having the amino acid tryptophan in positions 2 and 9. The amino-acid sequence of two other peptides could not be completely resolved by means of Edman degradation; however, these peptides could be allocated to the -YXFGLamide and the W2W9amide family, respectively, by comparison of retention times, co-elution and mass spectrometry. Both classes of neuropeptides strongly inhibit juvenile hormone biosynthesis in crickets but show no inhibiting effect on the corpora allata of the stick insect.

Marescalchi, O., Scali, V. & Zuccotti, M. (1998) Flow-cytometric analyses of intraspecific genome size variations in *Bacillus atticus* (Insecta, Phasmatodea). *Genome*, **41**(5): 629-635.

The stick insect *Bacillus atticus* comprises several populations with different chromosome numbers that are distributed over a large range of the Mediterranean basin. Here we have analyzed the DNA content of nine diploid and three triploid populations by flow-cytometry. The mean genome size of the diploids showed a significant decrease from east to west, ranging from 5.29 $\pm$ 0.12pg for the population from Crete (east) to 4.28 $\pm$ 0.10pg for the population from Sardinia (far west). This longitudinal trend of a decrease in genome size from east to west was also found for the triploid populations (from 6.80pg for

the population in Turkey to 6.08 ± 0.01pg for the population on the Isle of Rhodes). Differences in DNA content between populations belonging to the same species have been described in animals, but the evolutionary implications of these differences are as yet unclear. What emerges from the present study is a correlation between genome-size variations and geographic distribution. The adaptive nature of genome-size variations in response to environmental changes is discussed, and the class of DNA involved hypothesized.

Meloni, S., Mazzini, M. & Scapigliati, G. (1999) Ontogenesis of hemocytes in the stick insect *Bacillus rossius* (Rossi) (Phasmatodea, Bacillidae) studied with an anti-hemocyte monoclonal antibody. *International Journal of Insect Morphology and Embryology*, **28**(3): 247-252.

The monoclonal antibody BrH1, specific for haemocytes of the stick insect *Bacillus rossius*, was employed to study the appearance of haemocytes during embryogenesis. Laid eggs were collected for eight weeks, and cryosections were probed with the antibody. First positive cells were detected at the fifth week, and increased in number onwards. No peculiar differences were observed in the overall morphology between embryonic and non-embryonic haemocytes.

Novotny, V. & Basset, Y. (2000) Rare species in communities of tropical insect herbivores: Pondering the mystery of singletons. *Oikos*, **89**(3): 564-572.

The host specificity, taxonomic composition and feeding guild of rare species were studied in communities of herbivorous insects in New Guinea. Leaf-chewing and sap-sucking insects (Orthoptera, Phasmatodea, Coleoptera, Lepidoptera and Hemiptera-Auchenorrhyncha) were sampled from 30 species of trees and shrubs (15 spp. of *Ficus*, Moraceae, six spp. of *Macaranga* and nine species of other Euphorbiaceae) in a lowland rain forest. Feeding trials were performed with all leaf-chewers in order to exclude transient species. Overall, the sampling produced 80062 individuals of 1050 species. The species accumulation curve did not attain an asymptote, despite 950 person-days of sampling. Rare species, defined as those found as single individuals, remained numerous even in large samples and after the exclusion of transient, non-feeding species. There was no difference among plant species in the proportion of rare species in their herbivore communities, which was, on average, 45%. Likewise, various herbivore guilds and taxa had all very similar proportions of rare and common species. There was also no difference between rare and common species in their host specificity. Both highly specialised species and generalists, feeding on numerous plants, contributed to the singleton records on particular plant species. Predominantly, a species was rare on a particular host whilst more common on other, often related, host species, or relatively rare on numerous other host plants, so that its aggregate population was high. Both cases are an example of the "mass effect", since it is probable that such rare species were dependent on a constant influx of immigrants from the other host plants. These other plants were found particularly often among congeneric plants, less so among confamilial plants from different genera and least frequently among plants from different families. There were also 278 very rare species, found as one individual on a single plant species only. Their host specificity could not be assessed; they might have been either very rare specialists, or species feeding also on other plants, those that were not studied. The former possibility is unlikely since monophagous species, collected as singletons at the present sampling effort, would have existed at an extremely low population density, less than 1 individual per 10ha of the forest.

Passamonti, M., Mantovani, B. & Scali, V. (1999) Karyotype and allozyme characterization of the Iberian *Leptynia attenuata* species complex (Insecta Phasmatodea). *Zoological Science (Tokyo)*, **16**(4): 675-684.

Karyological and allozymatic characterizations of recently collected samples of the Iberian *Leptynia attenuata* complex support the occurrence of three genetically differentiated groups, for which parallel morphological observations evidenced only partially diagnostic characters. The groups are: the Portuguese population of Foia (Serra de Monchique), referred to as the nominal taxon, *L. attenuata*; the Spanish populations of the Sistema Central, referred to as *L. montana*; the populations of the Toledo district, referred to as *L. caprai*. These taxa seem to represent a case of incipient speciation, with chromosomal and genetic differentiation ahead of the morphological one. Chromosome repatternings, affecting autosomes as well as sex chromosomes, appear to go together with the evolutionary events.

Potvin, W. (2000) Soortbeschrijving van *Lonchodes amaurops* Westwood, PSG nr 100. *Phasma*, **10**(38): 34-37. [in Dutch].

Brief descriptions of the eggs, nymphs and adults of *Lonchodes amaurops* Westwood. A new stock from Damai, Sarawak was introduced by Kim D'Hulster in 1998. Housing, feeding and breeding this species are discussed. With two colour photographs and six black-and-white drawings, five by P.E. Bragg.

Potvin, W. (2000) E.H.B.O. bij een aanval van *Anisomorpha*. *Phasma*, **10**(38): 46. [in Dutch].

The author tells about an acid spraying attack he experienced by *Anisomorpha jamaicensis* right in the eye. If the eye is immediately washed with clean water, the pain quickly disappears and it is only a bit reddish for half an hour. If not, damage to the eye will certainly occur.

Potvin, W. (2000) Soortbeschrijving van *Parapachymorpha quadrispinosa* Hennemann et al., PSG nr 164. *Phasma*, **10**(39): 52-54. [in Dutch].

Brief descriptions of the adults, eggs and nymphs of *Parapachymorpha quadrispinosa* Hennemann, Gehler & Conle (PSG culture 164) are given. Their defensive behaviour is explained, and housing, feeding and breeding this parthenogenetic species are discussed. Includes one colour photograph and two black-and-white drawings.

Potvin, W. (2000) Wanneer een moeilijke soort gemakkelijk wordt. *Phasma*, **10**(39): 55-56. [in Dutch].

The relativity of words like easy and difficult to breed are discussed. Easy to breed species can become difficult and vice versa. Whether someone finds a species easy to breed, depends on its circumstances and the quality of the stock to start with. As phasmids are at the bottom of the food chain, they are in general very productive and should be easy to breed when given the right conditions. Species with a very efficient camouflage, mimicry and/or defensive behaviour are less productive in order to maintain a natural balance.

Potvin, W. (2000) Camouflage en mimicry: verschillend maar toch verwant. *Phasma*, **10**(39): 70. [in Dutch].

The difference between camouflage and mimicry is explained and some examples are given using phasmids.

Potvin, W. & van Herwaarden, H. (2000) Wandelende takken en bladeren opzetten en bewaren. *Phasma*, **10**(37): 3-8. [in Dutch]

Various methods and experiences for conserving dead stick insects are described. Techniques discussed include: chemical preservation, pinning the insects, temporary storage, killing, and storage of specimens in suitable insect cabinets. A method using vacuum conditions and silica gel is explained.

Predel, R., Kellner, R. & Gade, G. (1999) Myotropic neuropeptides from the retrocerebral complex of the stick insect, *Carausius morosus* (Phasmatodea: Lonchodidae). *European Journal of Entomology*, **96**(3): 275-278.

Myotropic neuropeptides were isolated from the retrocerebral complex of the stick insect, *Carausius morosus*, by using three HPLC steps. Bioactivity during purification was measured by heterologous bioassays monitoring the contractions of the hyperneural muscle and hindgut of the American cockroach. Additionally, fractions not active in these bioassays were tested in a homologous bioassay evoking contractions of the hindgut of *C. morosus*. Peptide sequence analysis and mass spectrometry yielded the following structures: Pro-Phe-Cys-Asn-Ala-Phe-Thr-Gly-Cys-NH2 (CCAP), pGlu-Thr-Phe-Gln-Tyr-Ser-His-Gly-Trp-Thr-Asn-NH2 (His7-corazonin) and Asp-Glu-Gly-Gly-Thr-Gln-Tyr-Thr-Pro-Arg-Leu-NH2 (Cam-PK-1). These neuropeptides are the first myotropins isolated from *C. morosus*. The most bioactive compound in the homologous bioassay, the *C. morosus*-hindgut assay, was CCAP.

Rabaey, K. & Potvin, W. (2000) Een nieuwe *Gratidia* soort uit Tanzania. *Phasma*, **10**(37): 19. [in Dutch]

A new *Gratidia* sp. from Tanzania has been introduced into culture by N. Cliquennois from France. Short notes about adults, eggs, nymphs and breeding of this small species are given.

Rasnitsyn, A.P. & Krassilov, V.A. (2000) The first documented occurrence of phyllophagy in pre-Cretaceous insects: Leaf tissues in the gut of the Upper Jurassic insects from southern Kazakhstan. *Paleontologicheskii Zhurnal*, **3**: 73-81.

Brachyphyllophagus phasma Rasnitsyn, n.gen. & n.sp. and *B. phantasus* Rasnitsyn, n.sp. are described from the Upper Jurassic of Kazakhstan. They are insects of uncertain systematic position, possibly belonging to the same order as embiids. The gut contents of these specimens, as well as of the stick insect *Phasmomimoides minutus* Gorochov, 2000 from the family Susumaniidae, is represented by the leaf fragments of *Brachyphyllum* or *Pagiophyllum* with cuticular characters of the Hirmerellaceae, accompanied by the pollen grains of *Classopollis*.

Sandoval, C. (2000) Persistence of a walking-stick population (Phasmatoptera: Timematodea) after a wildfire. *Southwestern Naturalist*, **45**(2): 123-127.

Species subjected to periodic catastrophes may persist locally through resistance or recolonization. I studied the fate of a population of the walking-stick *Timema cristinae* (Phasmatodea, Timemidae) after a natural fire in the chaparral of the Santa Ynez Mountains, California. Using genetically coded colour morphs I compared population structure before and after fire to determine that the population almost certainly survived the fire. Measurements of dispersal distance suggested that the area could not have been recolonized from adjacent non-burned sites. Coating of eggs with soil by females may have helped eggs to resist the heat of this fire. This study suggests a means for evaluating the occurrence of local extinction through analysis of genetically-based markers.

Sauer, A.E. & Stein, W. (1999) Sensorimotor pathways processing vibratory signals from the femoral chordotonal organ of the stick insect. *Journal of Comparative Physiology A Sensory Neural and Behavioral Physiology*, **185**(1): 21-31.

The femoral chordotonal organ of stick insects senses position and velocity of movements in the femur-tibia joint, as well as tibial vibration. While sensory information about large-scale tibial movements is processed by a well-known neuronal network and elicits resistance reflexes in extensor and flexor tibiae motoneurons, it is not yet known how sensory information about vibration of the tibia is processed. We investigated the transmission of vibration stimuli to tibial extensor motoneurons and their premotor interneurons. Vibration stimuli applied to the femoral chordotonal organ evoked responses in tibial extensor and flexor muscles. During ongoing vibration this response adapted rapidly. This adaptation had no effect on the motoneuronal response to large-scale tibial movements. Recording from premotor interneurons revealed that vibratory signals were processed in part by the same interneuronal pathways as (large-scale) velocity and position information. While only certain parts of the interneuronal reflex pathways showed little or no response during vibration stimuli, most neurons responded to both position or velocity stimuli and vibration at the femoral chordotonal organ. We conclude that sensory information about vibration of the tibia shares part of the interneuronal pathways that transmit sensory information about large-scale tibial movements to the motoneurons. [Work done with *Cuniculina impigra*].

Scali, V. & Tinti, F. (1999) Satellite DNA variation in parental and derived unisexual hybrids of *Bacillus* stick insects (Phasmatodea). *Insect Molecular Biology*, **8**(4): 557-564.

The Bag320 sequence family of satellite DNA (satDNA) has been found in some stick insect taxa: the bisexual *Bacillus grandii*, the related parthenogen *B. atticus* and their hybrids with *B. rossius*. However, under the same experimental conditions, the Bag320 sequences were not found in B. rossius. Bag320 sequences of the clonal hybrid *B. whitei* (= *B. rossius/grandii grandii*) intermingled with those of *B. grandii* in all plotted dendrograms. On the whole, satDNA features (restriction pattern, sequence variation, fluorescent in situ hybridization (FISH)), allozymes and karyology support a relatively recent origin of *B. whitei*. Our investigations on unisexual hybrids of *Bacillus* also suggested that their origin and clonal reproduction allow the occurrence of different sequence subsets of limited variability in isolated populations stemming from the hybridization focus.

Schmitz, J. & Stein, W. (2000) Convergence of load and movement information onto leg motoneurons in insects. *Journal of Neurobiology*, **42**(4): 424-436.

The interaction of two feedback loops was investigated: one regulating cuticular stress in the stick insect's leg and the other controlling leg posture. Exclusive stimulation of either of the two relevant sense organs, the load-sensitive trochantero-femoral campaniform sensilla (CS) or the position-/movement-sensitive ventral coxal hairplate (cxHPv), elicits resistance reflex responses in the retractor and the protractor coxae motoneuron pools. Concurrent application of both stimulus modalities reveals that the strength of the postural feedback response is dependent on sign and amplitude of the load feedback response and vice versa. This superposition of the two reflex responses appears to be non-linear. The results indicate that the CS information is underlying a force control function in this six-legged animal. It is hypothesized that the force control of each single leg could help to optimize the force distribution of the six-legged system, even - due to the mechanical coupling - without explicit neuronal pathways. On the level of the single leg control it was studied whether the different information provided by the two feedback transducers converge on the level of retractor coxae motoneurons or whether this information is fully pre-processed at the level of premotor

interneurons. It is shown here that the hairplate afferents make direct, excitatory connections with the retractor motoneurons. Studies of the motoneurons' membrane conductances during exclusive CS stimulation reveal that both, excitatory as well as inhibitory synaptic drive is delivered onto the retractor motoneurons. Thus, the motoneuronal membrane is shown to be an important stage for the sensor fusion of the two modalities. [Work done with *Carausius morosus*].

Seow-Choen, F. (1998) *Phobaeticus lambirica*, n.sp., and *Dajaca chani*, n.sp.: new species of stick insects from East Malaysia (Phasmida: Phasmatidae). *Serangga*, **3**(1): 39-48.

Phobaeticus lambirica n.sp. and *Dajaca chani* n.sp., two new species of stick insects are described from Lambir National Park, Sarawak and Kinabalu Park, Sabah, respectively.

Seow-Choen, F. (1999) The Phasmida. *In* Briffett, C. & Chew, H.H. *State of the Natural Environment in Singapore*. Nature Society (Singapore).

Brief review of human pressures on phasmids in Singapore. The paper includes a checklist of species.

Seow-Choen, F. (2000) Illustrated guide and key to the *Haaniella* (Phasmida: Bacillidae: Heteropteryginae) species of Malaysia. *Serangga*, **5**(1): 149-164.

The stick insects of the genus *Haaniella* from Malaysia are represented by six species. A key to all species and illustrations are provided.

Seow-Choen, F., Seow-En, I. & Seow-An, S. (2000) Kleur van wandelende takken en wandelende blaadjes. *Phasma*, **10**(38): 31-33. [in Dutch].

A translation of an article from *Nature Malaysiana* **21**(2): 40-47 (published 1996), discussing colours in phasmids. Two colour photographs from the original article are included.

Seow-Choen F. & Goh, Y.Y. (1999) New records of stick insects from Pulau Tioman, peninsular Malaysia, including description of a new species of *Abrosoma* (Phasmida: Pseudophasmatidae: Aschiphasmatinae). *Raffles Bulletin of Zoology*, Supplement 6: 263-269.

The phasmid fauna of Pulau Tioman is described. Fifteen species are recorded, including *Abrosoma johorensis*, new species.

Zompro, O. (1998) Vorläufige Liste der von Ingo Fritzsche in Thailand gesammelten Stabschrecken (Insecta: Orthoptera: Phasmatodea). *Arthropoda*, **6**(2): 6-8. [in German]

This article lists the phasmid material collected by Ingo Frtzsche from August 1997 to January 1998 in the Nakhon Ratchasima region of Thailand.

Zompro, O. (1998) Neue Phasmiden aus Neuguinea (Insecta: Phasmatodea). *Reichenbachia, Staatliches Museum für Tierkunde Dresden*, **32**(25): 157-163. [in German]

From the collections of the Staatliches Museum für Tierkunde, Dresden, Germany and the Museum d'Histoire Naturelle, Geneva, Switzerland, four new species of Phasmatodea are described: *Leosthenes emmrichi*, *Phyllium groesseri*, *Breviphetes rubrus*, and *B. viridis*. A new genus, *Breviphetes* n.gen. is described for *Periphetes rammei* Günther, 1929, which is the type species, and the two new species described here. The egg of *Heterocopus carli* Günther, which appears to be a member of *Pachymorpha* Gray, is described for the first time.

Zompro, O. (1998) Stabschrecken von der Insel Utila, Honduras (Phasmatodea). *Entomologische Zeitschrift*, **108**(5): 212-216. [in German]

A new species of the genus *Sermyle* Stål, *S. kujawskii* Zompro n.sp., and its egg are described and figured as well as a new subspecies of *Pseudobacteria picta* (Brunner) and its egg. These two taxa were collected on the Honduras island of Utila. Some information on the breeding of *P. picta utilaensis* n.ssp. is given.

Zompro, O. (1998) Neue Phasmiden aus Venezuela und Ecuador (Phasmatodea). *Entomologische Zeitschrift*, **108**(11): 456-459. [in German]

Two new species of Phasmatodea are described from Ecuador (*Acanthoclonia minima* n.sp.) and Venezuela (*Ocnophila (Parocnophila) carinata* n.subgen., n.sp.). For the latter species a new subgenus is erected.

Zompro, O. (1999) Neue Stabschrecken aus Thailand (Insecta: Phasmatodea). *TenDenZen Supplement 1999, Übersee-Museum Bremen*, pp. 49-60. [in German]

Four species of phasmids from Thailand, Nakhon Ratchasima, are described as new. *Paragongylopus plaumanni* n.sp., *Gratidia fritzschei* n.sp., *Phaenopharos khaoyaiensis* n.sp. and *Gratidia luethyi* n.sp. from Ko Tao; the description of *P. khaoyaiensis* includes a key to the species of this genus. The male of *P. plaumanni* is teh first one to be known in *Paragongylopus* Chen & He, 1997.

Zompro, O. (1999) Die Phasmidensammlung des Übersee-Museums Bremen. *TenDenZen Supplement 1999, Übersee-Museum Bremen*, pp. 61-71. [in German]

The phasmids in the collection of the Übersee-Museum Bremen are listed. The collection includes types of four species described by Brunner von Wattenwyl, Redtenbacher and Zompro; one type of Redtenbacher's is missing. A new genus, *Medauroidea* is erected for *Clitumnus extradentatus* Brunner, 1907.

Zompro, O. (1999) *Microphasma*, eine neue Stabschrecken-Gattung aus Sri Lanka (Phasmatodea: Pachymorphinae). *Entomologische Zeitschrift*, **109**(3): 124-127. [in German]

A new genus of the phasmatodean subfamily Pachymorphinae is described from Sri Lanka. The two species of *Microphasma* n.gen., *M. prima* n.sp., the type species, and *M. secunda* n.sp. are some of the smallest phasmids. The new genus is known only from the female sex and is endemic to Sri Lanka.

Zompro, O. (2000) SEM-Studie des Eies von *Bacteria nodulosa* Redtenbacher, 1908 und die Erstbeschreibung des Weibchens (Phasmatodea: Heteronemiidae, Heteronemiinae, Heteronemiini). *Entomologische Zeitschrift*, **110**(6): 171-174. [in German]

The female and the egg of *Bacteria nodulosa* Redtenbacher, 1908 are described for the first time and the male is redescribed. A lectotype is designated. The egg was examined using an SEM. The adults and eggs are illustrated.

Zompro, O. & Eusebio, O.L. (2000) *Phasmatotaenia elongata*, n.sp., a new stick insect (Phasmatodea: Phasmatidae) from the Philippine islands. *Philippine Entomologist*, **14**(1): 61-64.

Phasmotaenia elongata n.sp. is described and illustrated from the Philippines. It differs from the only species of *Phasmotaenia* Navas, *P. sanchezi* (Bolivar) in terms of body and egg morphology. *P. elongata* is restricted to the northern part of Luzon island.