

**Research article**Submitted: December 5<sup>th</sup>, 2018 - Accepted: December 15<sup>th</sup>, 2018 - Published: December 31<sup>st</sup>, 2018***Amphoraceras rothschildi* and *A. jordani* sp. n.: two sibling species  
(Lepidoptera: Erebidae)**

Alberto ZILLI

Natural History Museum, Life Sciences DC2-2N - Cromwell Road, SW7 5BD London, UK - a.zilli@nhm.ac.uk

**Abstract**

One new species of *Amphoraceras* which has so far remained unrecognised and intermingled within *A. rothschildi* is described as *A. jordani* sp. n. Both species are endemic to New Guinea, where they even happen to locally coexist and overlap phenologically. Main diagnostic features between the two taxa occur in the development of the unusual amphora-shaped structure present on male antenna, which is herewith detailed morphologically, aspects of the habitus and features of the genitalia.

**Key words:** new species, New Guinea, antennae.

urn:lsid:zoobank.org:pub:

**Introduction**

Due to its conspicuous habitus and most unusual configuration of the male antenna, *Amphoraceras rothschildi* Bethune-Baker, 1904, type species of the monobasic genus *Amphoraceras* Bethune-Baker, 1904, is deservedly reputed one of the most iconic species of Erebidae worldwide (Figs 1-4). Originally figured by Bethune-Baker (1904), then Hampson (1913), but widely popularised only after its illustration in Seitz's "Die Gross-Schmetterlinge der Erde" (Gaede, 1938), this species, loosely resembling although not directly related to the Oriental *Thyas javanica* (Gaede, 1917) (Figs 17-18), is however poorly represented in collections, in that strictly a Papuan endemic. Rarity in collections has therefore prevented so far a careful appreciation of its variability. It is therefore with much surprise that during re-curation of the erebid collections of the Natural History Museum (London), the assembling of an adequately long series revealed that this could unambiguously be split into two distinct groups. One of these corresponds with the original concept of *A. rothschildi* represented by Bethune-Baker's two known syntypes from Dinawa (Papua New Guinea) collected by Antwerp Edgar Pratt (Pratt & Pratt, 1906), while the other consists of specimens characterised externally by the stronger developed amphora-shaped structure of the male antenna, and subtle but constant and reliable differences in habitus. As no intermediates could be found and specimens of the two series happen to be geographically intermingled, so as to rule out any instances of geographic variability, a new species based on the second series is therefore described herein.

**Material and methods**

27 specimens (15♂♂, 12 ♀♀) of *Amphoraceras rothschildi* Bethune-Baker, 1904, preserved in the collection of the Natural History Museum (London), including the two known syntypes, have been examined. Their data are as follows: [**Indonesia**] [**West Papua Province**]: 1♂, 2♀♀, Central Arfak Mts, Ninay Valley, 3500 ft, Nov '08 to Jan '09 (Rothschild Bequest); 5♂♂, 2♀♀ Wandammen Mts., 3-4000 ft, Nov. 1914, A., C. & F. Pratt (Joicey Coll., Joicey Bequest & accession 1919-144); [**Papua Province**]: 2♂♂, 1♀, Menoo Valley, Weyland Mts, Mt Kunupi, 6000 ft, Nov. & Dec. 1920, C., F. & J. Pratt (Joicey Bequest & Rothschild Bequest); [**Papua New Guinea**]: Syntypus ♂, Dinawa, B[ritish] New Guinea, 4,000 ft., Aug., 1902, Coll. A. E. Pratt (Type/*Amphoraceras Rothschildii* [sic]/ G.T.B.-Baker Coll. Brit. Mus. 1927-360./NHMUK010914540); Syntypus ♀, Dinawa, B[ritish] New Guinea, 4,000 ft., Aug. 1902, Coll. A. E. Pratt (Type/*Amphoraceras Rothschildii* [sic]/ G.T.B.-Baker Coll. Brit. Mus. 1927-360.); 1♀, Buntibasa dist., Kratke Mts, 4000-5000', April 1932 (F. Shaw Mayer) (Rothschild Bequest); 1♂, Stephansort (Webster) (Rothschild Bequest); 1♂, Biagi, Mambare R[iver], 5000 ft, Mrch. 06 (A.S. Meek) (Rothschild Bequest); 1♀, *ibidem*, April 06 (A.S. Meek) (Rothschild Bequest); 1♀, Ekeikei, 1500 ft, July 1903, A.E. Pratt; 1♂, Mafalu, 6000 ft, August 1903, A.E. Pratt; 1♂, 1♀, Hydrographer Mts, 2500 ft, Jan.-May 1918 (Eichorn Bros.) (Joicey Bequest & Rothschild Bequest); 1♂, *ibidem*, Feb. 1918 (Eichorn Bros.) (Rothschild Bequest); 2♀♀, *ibidem*, Mrch. 1918 (Eichorn Bros.) (Roth-

schild Bequest); 1♂, *ibidem*, April 1918 (Eichorn Bros.) (Rothschild Bequest).

Of the new species, 41 specimens (22♂♂, 19 ♀♀) have been examined, as detailed in the taxonomic section below. Further three specimens (2♂♂, 1♀) of the new taxon from Morobe Province (Papua New Guinea), misidentified as *A. rothschildi*, have been inspected online at BOLD (2018).

Due to the close similarity of the two species, correct association of relative sexes was somewhat open to uncertainty. Considering that males can be easily distinguished after the structural characters detailed here below, and females can consistently be arranged into two groups on the basis of size and a difference in pattern, females have been associated to males according to the following criteria: (a) the series of larger-sized females was associated to that of larger-sized males; (b) more recurrent syntopic occurrence and (c) 100% match of COI barcodes between male EPNG7968-12 of the new species and syntopic female EPNG7969-12 treated in BOLD (2018). Following this procedure, no outliers remained and both male and female syntypes of *A. rothschildi* turned out to be conspecific, which made the selection of a lectotype for this taxon unnecessary.

For genitalia preparations, abdomens were removed and macerated overnight in cold 10% KOH (aqueous). They were then dissected, descaled and the genitalia cleaned, all parts stained in saturated chlorazol black (75% ethanol) for 20 seconds and then transferred to absolute ethanol. Vesicae were everted with an insulin syringe. Male antennae were prepared after the same procedure, although without staining, and folded over antennomeres were unrolled to show their degree of development. All dissected parts have been permanently mounted onto slides in Euparal (ASCO Laboratories). Pictures of adults were taken with a camera Canon Eos 600D equipped with lenses Sigma DG Macro 70mm, those of genitalia with a Canon 5DSR with lenses Canon 58mm, equipped with a Stackshot system operated by software Helicon Remote (version 3.8.4 W); the latter were eventually stacked with software Helicon Focus (version 6.7.1). Final cropping and editing of pictures were performed with Adobe Photoshop CC 2014.

## Taxonomic part

*Amphoraceras jordani* sp. n. (Figs 5-8, 10, 12, 15-16)

### Description

Male (Figs 5, 7)

*Forewing length*: 33-38 mm ( $x = 36.37$ ,  $N = 22$ ).

*Head*: Large, frons and vertex densely clothed, chocolate brown-coloured; eye large, globular; antenna with amphora-shaped structure of flagellum long and smoothly arcuate; this structure consists of extremely transversally widened antennomeres which fold themselves over along

the longitudinal axis of flagellum, thus originating a lumen open distally evidently for detection of female scent, whereas the lateral slit and basal opening of the structure appear to be sealed by its tightly appressed free edges and dense scale coverage (Figs 10, 12); labial palpus stout, up-curved, thickly clothed, with voluminous clubbed third joint, distinctly protruding beyond head profile; haustellum present.

*Thorax*: Prothorax greatly developed with conspicuous patagium forming hood concolorous with vertex; tegulae broad, triangular, ash grey to mild brown-coloured; meso- and metanotum thick, conspicuously tufted, exhibiting dark brown triangle. Forewing broad, with smoothly convex costa and termen, apex slightly falcate; ground colour irregular mottled with various shades of brown and finely irrorated with dark brown scales; subbasal line feeble or indistinct; antemedial line reddish brown, stronger at costa, slightly concave at discal cell, greatly outwardly bowed below this, and concave in anal field, delimiting greyish brown basal field; postmedial line indistinct or as an irregularly waved brown hue on costal field, then obliquely running from  $M_1$  towards inner margin of wing at one third from base, reddish brown-coloured; both lines adjoined on side facing median field by additional thin brown line, indistinct or blurred towards costa albeit well expressed below discal cell, where together with paler-lined veins they delimit blotches slightly greyer than ground colour, the line adjoining postmedial distinctly scalloped inwards at veins; orbicular stigma conspicuous, circular, blackish brown-filled with thin, pale pinkish brown peripheral ring, reniform stigma large, lined dark brown, filled with pale pinkish brown and various blackish brown blotches; distal field irregularly suffused with various hues of pale and chocolate brown, occasionally greyish or reddish also, preapical area with dark brown trapezoid mark, and antemarginal zone with one series of dark or reddish brown inter-venular dots; fringe thin, as a pale pinkish brown line edging termen. Hindwing blackish brown basally, pale orange from disc towards termen, where dark blackish brown suffusion develops, especially between  $M_1$  and  $1A+2A$ . Legs robust and tufted pale orange from base to tibiae. Underside of thorax conspicuously tufted pale orange; fore- and hindwing uniformly orange-coloured with sparse irroration of dark brown scales.

*Abdomen*: Pale ash grey to mild brown-tufted dorsally at base, then conspicuously blackish brown-coloured, except at sides and on last segments, pale orange. Underside homogeneously pale orange.

*Male genitalia*: Tegumen dome-shaped, shorter than vinculum, this broad, with arms of uniform width and without produced saccus, valvae asymmetrical, left one broad, distally blunt, with stout, broad-based, heavily sclerotised arcuate dorsal process slightly spatulate at apex, right valva slender, ending with long thin ventral process overpassing half of uncus and small, finger-like sclerotised dorsal process. Uncus strongly hooked, scaphium flat. Juxta

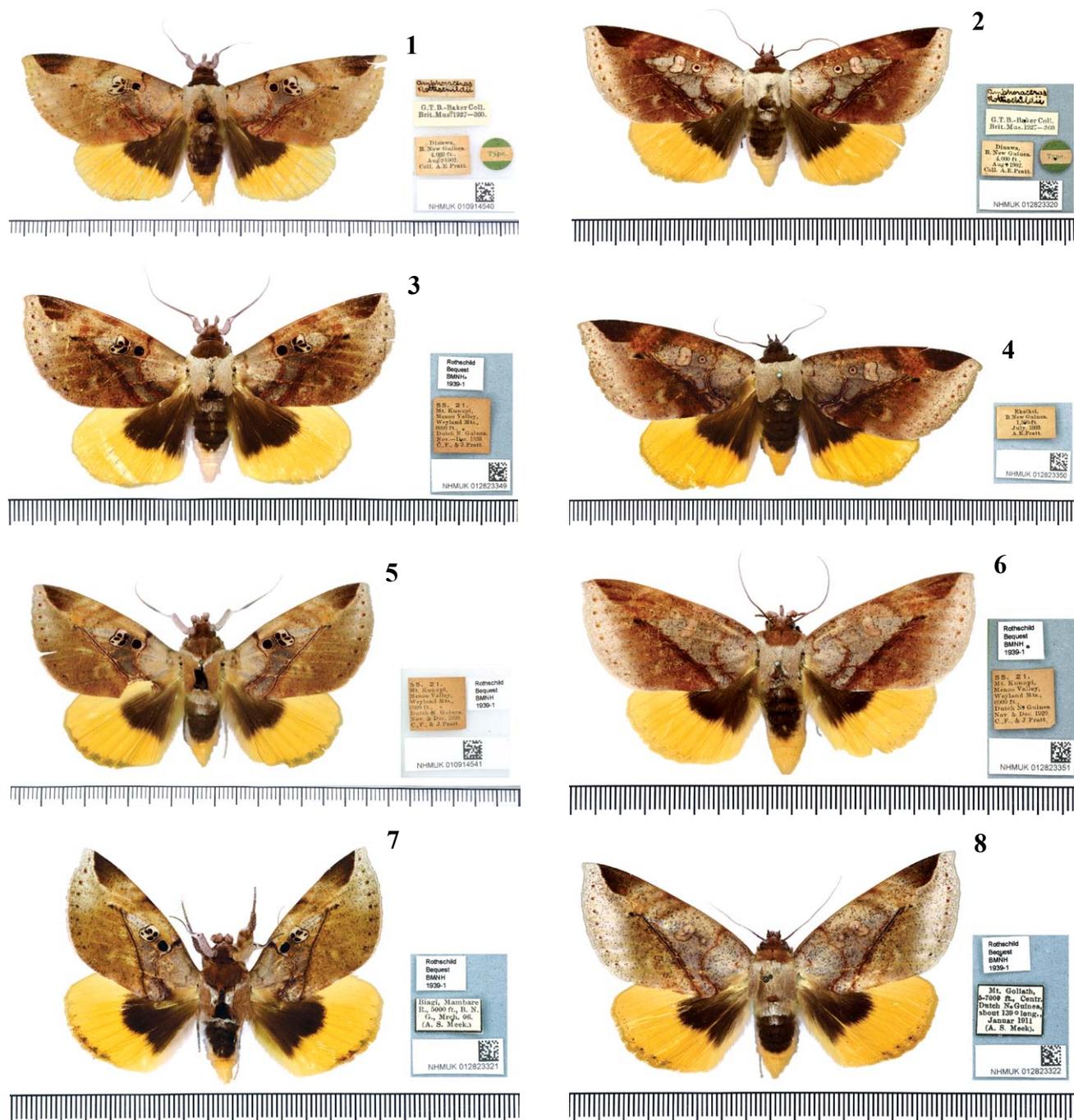
broad and flat, asymmetrical, extended anteriorly into almost complete periphallus plate, this very narrow at left and broadly expanded at right (Fig. 15a). Aedeagus markedly sigmoid, widest at base in correspondence of voluminous coecum, vesica "T"-shaped with some small basal diverticula and long paired opposed tubular diverticula of approximately same length, one narrow and convolute,

acutely tipped, the other wider, showing slightly polygonal path, with hump at middle and reclinate apex (Fig. 15b).

Female (Figs 6, 8)

*Forewing length*: 34-39 mm ( $x = 36.89$ ,  $N = 19$ ).

*Head*: As in male albeit appreciably smaller with less thick vestiture, and with filiform antenna, slenderer palpus and thin, rod-like third joint.



**Figs 1-8** – Adults of *Amphoraceras* spp.: **1**, *A. rothschildi*, syntypus ♂, [Papua New Guinea] Dinawa; **2**, *ibidem*, syntypus ♀, same locality as fig. 1; **3**, *ibidem*, ♂, [Indonesia: Papua Province] Mt Kunupi; **4**, *ibidem*, ♀, [Papua New Guinea] Ekeikei; **5**, *A. jordani* sp. n., holotypus ♂, [Indonesia: Papua Province] Mt Kunupi; **6**, *ibidem*, paratypus ♀, same locality as fig. 5; **7**, *ibidem*, paratypus ♂, [Papua New Guinea] Biagi; **8**, *ibidem*, paratypus ♀, [Indonesia: Papua Province] Mt Goliath.



9



10

**Figs 9-10** – Heads of male *Amphoraceras* spp.: **9**, *A. rothschildi*, Mt Kunupi; **10**, *A. jordani*, holotypus, Mt Kunupi.

*Thorax*: As in male albeit less stout and with smaller-sized patagium; meso- and metanotum not thickly tufted, concolorous with tegulae or at most only producing small warm brown posterior triangle. Forewing as in male but with less bowed costa and weaker dark markings, orbicular stigma in particular being very small and filled only with pale pinkish brown and reniform devoid of dark blotches. Hindwing as in male, with only feeble blackish

irroration along outer edge. Legs slenderer than in male because of reduced tufting. Underside as in male.

*Abdomen*: As in male.

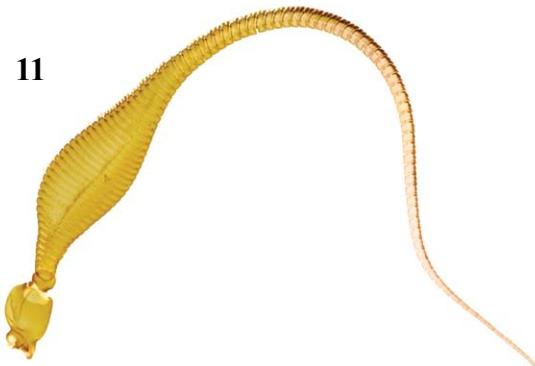
*Female genitalia*: Ostium bursae eccentric, consisting of infundibular opening from oval membranous fenestra positioned on right basal corner of weakly sclerotised sternum A7, this triangular in outline, bearing conspicuous transverse thumb-like projection arising from posterior edge of fenestra directed towards centre of sternum; ductus bursae tubular narrow, entirely membranous and smoothly arched, leading to large ovoid bursa copulatrix, appendix bursae arising from cervical part of bursa next to junction with ductus, voluminous, of approximately uniform width but tapered at apex, and markedly convolute, ductus seminalis from very tip of appendix; segment A8 belt like, highest dorsally, leaving narrow midventral area, apophyses anteriores long rod-like; ovipositor roughly conical, with large soft, richly setose papillae anales, apophyses posteriores, approximately 1.3 times as long as anteriores (Fig. 16).

*Variability*: Variation occurs in hue of both ground colour and various pattern elements, so for degree of expression of the latter.

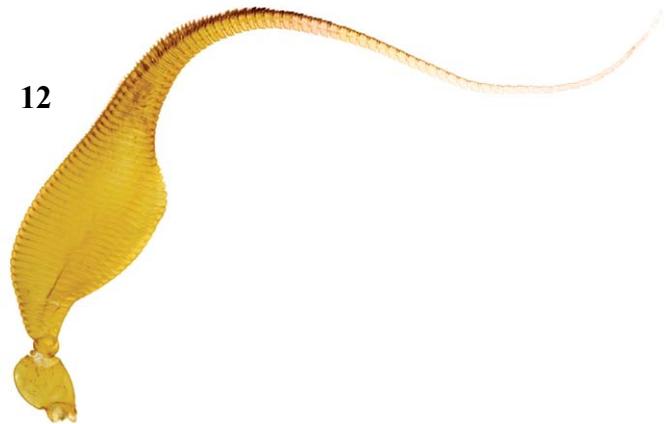
**Material examined**. Holotypus: ♂, [Indonesia: Papua Province]: [55. 21.] Mt. Kunupi, Menoo Valley, Weyland Mts, 6000 ft., Dutch N[ew] Guinea., Nov. & Dec. 1920. C., F. & J. Pratt (Rothschild Bequest BMNH 1939-1/NHMUK010914541), in Natural History Museum, London.

Paratypes: [Indonesia] [West Papua Province]: 1♀, Arfak Mts, Angi Lakes, 6000 ft, Jan-Feb. 1914, A., C. & F. Pratt (Joicey Bequest); 1♀, Central Arfak Mts, Ninay Valley, 3500 ft, Nov'08 to Jan'09 (Rothschild Bequest); 1♂, Wandammen Mts, 3-4000 ft, Nov. 1914, A., C. & F. Pratt (Joicey Bequest); [Papua Province]: 4♂♂, 6♀♀, Menoo Valley, Weyland Mts, Mt Kunupi, 6000 ft, Nov. & Dec. 1920, C., F. & J. Pratt (Joicey Coll., Joicey Bequest &

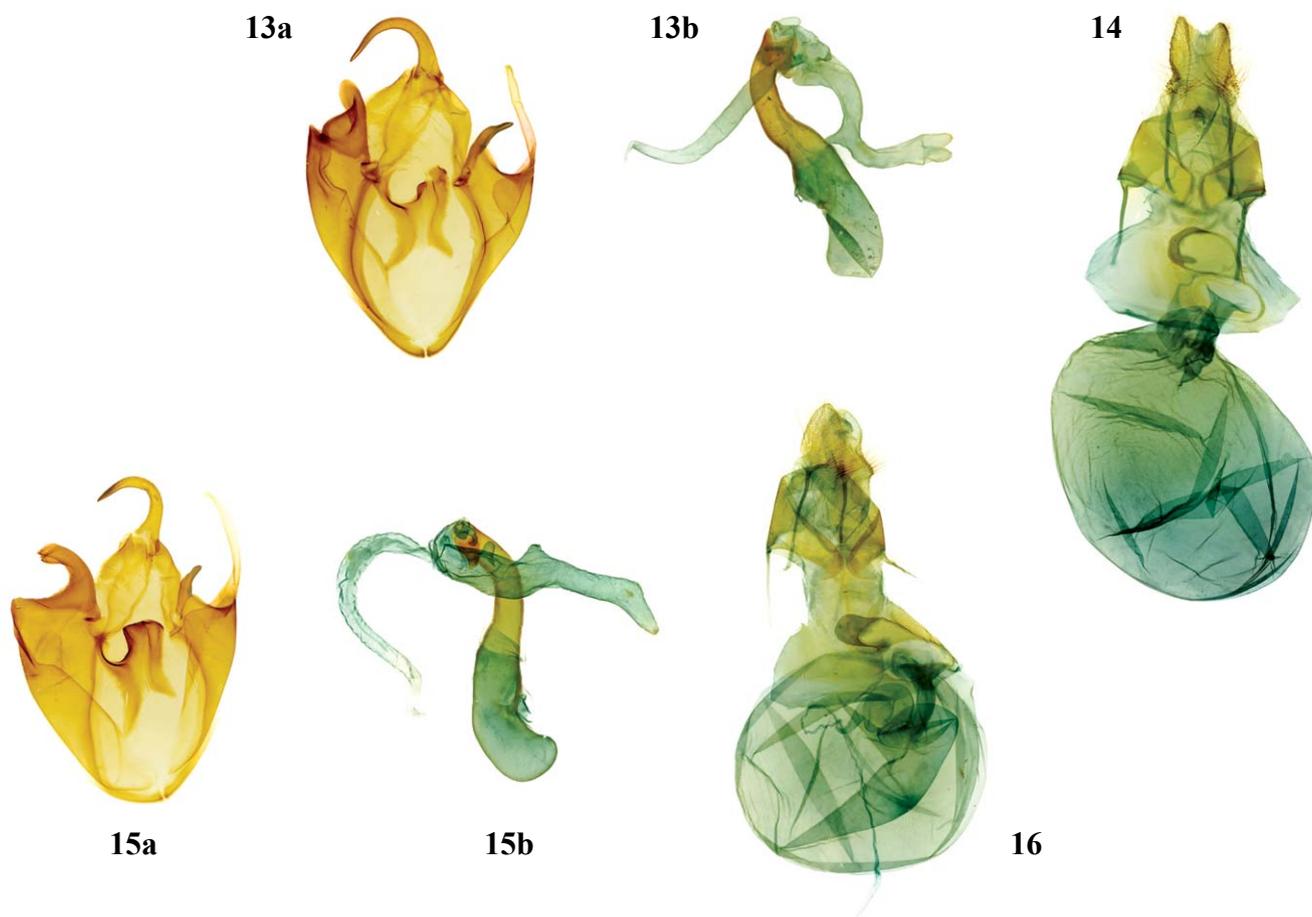
11



12



**Figs 11-12** – Right antennae of male *Amphoraceras* spp. (same scale sized): **11**, *A. rothschildi*, [Papua New Guinea] Hydrographer Mts; **12**, *A. jordani*, paratypus, [Papua New Guinea] Angabunga River.



**Figs 13-16** – Genitalia of *Amphoraceras* spp.: **13ab**, *A. rothschildi*, ♂, same specimen as fig. 11; **14**, *ibidem*, ♀, Mt Kunupi; **15ab**, *A. jordani* sp. n., paratypus ♂, same specimen as fig. 12; **16**, *ibidem*, paratypus ♀, Mt Kunupi; **a** = male apparatus; **b** = aedeagus.

Rothschild Bequest); 2♂♂, 1♀, *ibidem*, Dec. '20. – Jan. '21., C., F. & J. Pratt (Joicey Bequest & Rothschild Bequest); 1♀, Mt. Goliath, about 139° long., 5-7000 ft, Januar 1911 (A.S. Meek) (Rothschild Bequest); 1♂, *ibidem*, Februar 1911 (A.S. Meek) (Rothschild Bequest); [**Papua New Guinea**]: 1♀, Madang Dist., Finisterre Mts, Moro. C., 5550 ft, 30.x.-15.xi.1964 (M.E. Bacchus); 1♀, Mo-

robe District, Edie Creek, 7000 ft, 18-22.ix.1964 (M.E. Bacchus); 2♂♂, Mt Tafa, 8500 ft, iii.1934 (L.E. Cheesman); 6♂♂, 1♀ Angabunga R[iver], affl[uent] of St Joseph R[iver], 6000 ft, “upwards”, Nov. 04.–Febr.05 (A.S. Meek) (Rothschild Bequest); 2♂♂, 3♀♀, Mambare R[iver], Biagi, 5000 ft, I.–IV.06 (A.S. Meek) (Adams Bequest, G.T.B.-Baker Coll. & Joicey Bequest); 2♂♂, 2♀♀,



**Figs 17-18** – Adults of *Thyas javanica*: **17**, ♂, [Indonesia] Sumatra, North Korintji Valley; **18**, ♀, same locality as fig. 17.

*ibidem*, Mrch. 06 (A.S. Meek) (Rothschild Bequest); 1♂, 1♀, *ibidem*, April 06 (A.S. Meek) (Rothschild Bequest); all in Natural History Museum, London.

**Distribution.** Distributed all over the mountainous regions of New Guinea from the Doberai Peninsula to the Owen Stanley Range.

**Molecular data.** This species has been molecularly bar-coded under the name of *A. rothschildi* in BOLD (2018), where three specimens from Morobe Province (Papua New Guinea) owned by the United States National Museum (Washington) which show its characteristic features are present (BOLD records/museumIDs: EPNG7968-12/USNM ENT-00800411; EPNG7969-12/USNM ENT-00800412 and YAWAN859-14/USNM ENT-00646564).

**Etymology.** The species is named after the esteemed entomologist H.H. Karl Jordan (1861-1959) who long collaborated in the study of world Lepidoptera with L. Walter Rothschild (1868-1937), to whom the only other species of *Amphoraceras* so far known has been dedicated.

**Diagnostic remarks.** The new species is a remarkable sibling of *Amphoraceras rothschildi* characterised by a sort of enhancement of the male secondary sexual characters. In fact, despite the larger size of male *A. rothschildi*, whose forewing length spans 36–42 mm ( $x = 38.53$ ,  $N = 15$ ), that of *A. jordani* has longer and bigger amphora-like structure of the antenna not just in relative but in absolute terms, bigger antennal scape, larger labial palpi and more swollen thorax with thicker, more conspicuous tufts. As a result, the patagium hood of male *A. jordani* is longer and thicker, hence more dorsally protruding than that of its relative. As a matter of fact, when seen from above, the patagium flaps of male *A. jordani* project into “V”-shape towards mesonotum, whereas those of *A. rothschildi* form a normal collar not dissimilar from that of the female. As also the mesothorax of *A. jordani* is stronger developed, the whole pro-mesothorax of the new species is more gibbous than that of its congener (Figs 9–12). Other external differences reside in the more conspicuously bulged labial palpi beyond frons and the stronger dark terminal irroration of the hindwing in the male of the new species. Regarding the female, that of *A. rothschildi* is larger too (forewing length 38–42 mm,  $x = 40.50$ ,  $N = 12$ ), whereas in habitus this happens to regularly show a dark-filled orbicular stigma, contrary to the extremely small, pale-filled one of *A. jordani*. In the male genitalia, the new species bears a stronger, longer and more curved dorsal process of valva than that of *A. rothschildi*, in which this process is shorter, broadly spatulate and also exhibits a greatly humped base; furthermore, the corresponding process of right valva is shorter in *A. jordani*, whereas the long thin ventral process is longer. The periphallal expansion of juxta to the right of the aedeagus is broader in *A. jorda-*

*ni*, whose thickest vesical diverticulum is also thicker and straighter than that of *A. rothschildi*, and not apically bifurcate; the uncus of *A. jordani* is smaller (Figs 13, 15). In the female genitalia main differences reside in the less eccentric, more mesially-positioned fenestra of ostium bursae on sternum A7, the markedly larger thumb-like process on same sternum, the straighter ductus bursae and the smaller, shorter and less convolute appendix bursae of *A. rothschildi* (Figs 14, 16).

## Discussion

*Amphoraceras rothschildi* and *A. jordani* happen to geographically overlap over large part of New Guinea, occurring even syntopically in places such as Mt Kunupi, Ninay Valley, Wandammen Mts or Biagi. On the basis of the material examined there is no evidence that they are altitudinally or phenologically displaced. Their degree of morphological differentiation is not particularly pronounced in genitalia of either sexes, although they differ in a number of details, but is most evident in male secondary sexual characters, which evidently play a major role in species isolation. When compared to ratios between body parts in *A. rothschildi*, several features of male *A. jordani* involved into mate locating behaviour, such as the antennal amphora for partner scent detection or thorax for empowering flight, do not stand in isometric relationships and show a stronger development with respect to other characters.

Hypotheses on the speciation pathway of this pair of largely overlapping sibling species are currently premature as they may involve allopatric isolation followed by secondary expansion or some sort of ecological specialisation in sympatry. In any case they will have to take into account the complex paleogeographic history and environmental vicissitudes which affected constitution of the Papuan biota (cf. Marshall & Beehler 2006).

## References

- Bethune-Baker G.T. 1904. New Lepidoptera from British New Guinea. *Novitates zoologicae*, 11 (2): 367–429, pls 1–6.
- BOLD (Barcode of Life Data System) 2018. BOLD:ACG0634 (“*Amphoraceras rothschildi*”). v3.boldsystems.org (accessed 25.11.2018).
- Gaede M. 1938. Unterfamilie Catocalinae, pp. 454–496, pls 44–56. In: Seitz A. (ed.). *Die Gross-Schmetterlinge Erde* 11 (Indo-australischen Faunengebieten: Eulenartige Nachtfalter). A. Kernen, Stuttgart.
- Hampson, G.F. 1913. *Catalogue of Lepidoptera Phalaenae in the British Museum* 12. Trustees of the British Museum, London, XIII + 626 pp.
- Marshall A.J., Beehler B.M. (eds). 2007. *The Ecology of Indonesian Papua*. 2 vols. Periplus Editions, Singapore, 749 + 768 pp.
- Pratt A.E., Pratt H. 1906. *Two years among New Guinea cannibals: a naturalist's sojourn among the aborigines of unexplored New Guinea*. J.P. Lippincott Co., Philadelphia, 360 pp., 1 map.