

On the systematics of *Anania* Hübner, 1823 (Pyraloidea: Crambidae: Pyraustinae)

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Abstract. Currently, Pyraustinae (Lepidoptera: Pyraloidea: Crambidae) are split into many genera that often contain a small number of species only. This classification is largely influenced by traditional and typological concepts and do not necessarily reflect natural relationships. Thus, we encourage the idea to fuse taxa based on synapomorphies, as suggested by Leraut (2005), who argued, that an elongated, serrated sclerite of the phallus in males and a digitiform structure freely extending into the antrum in females is apomorphic for members of *Anania* Hübner, 1823. Screening the literature, we found four further species belonging to this monophylum: *Anania hasanensis* (Kirpichnikova, 1998) (*Opsibotys*) **comb. n.**, *Anania luteorubralis* (Caradja, 1916) (*Pyrausta*) **comb. n.**, *Anania obtusalis* (Yamanaka, 1987) (*Perinephela*) **comb. n.**, and *Anania shafferi* (Speidel & Hanigk, 1990) (*Algedonia*) **comb. n.** Investigating Chinese Pyraustinae, we also found these characters in taxa which so far were not assigned to *Anania*. As a result, *Pronomis* Munroe & Mutuura, 1968 **syn. n.**, *Tenerobotys* Munroe & Mutuura, 1971 **syn. n.**, and *Udonomeiga* Mutuura, 1954 **syn. n.** are synonymized with *Anania*. The species formerly treated in *Pronomis* are transferred to *Anania*: *Anania delicatalis* (South, 1901) (*Pyrausta*) **comb. n.**, *Anania flavicolor* Munroe & Mutuura, 1968 (*Pronomis*) **comb. n.**, *Anania profusalis* (Warren, 1896) (*Opsibotys*) **comb. n.** The species and subspecies formerly treated in *Tenerobotys* are transferred to *Anania*: *Anania subfumalis* Munroe & Mutuura, 1971 (*Tenerobotys*) **comb. n.**, *Anania subfumalis continentalis* (Munroe & Mutuura, 1971) (*Tenerobotys*) **comb. n.**, *Anania teneralis* (Caradja, 1939) (*Hapalia*) **comb. n.**, and *Anania teneralis tsinlingalis* (Munroe & Mutuura, 1971) (*Tenerobotys*) **comb. n.** *Anania vicinialis* (South, 1901) **comb. n.** (*Pyrausta*) is transferred from *Udonomeiga* to *Anania*. The apomorphic characters of *Anania* are also shared by the afrotropic *Ethiobotys* Maes, 1997, **syn. n.**, and the species formerly treated therein are transferred to *Anania*: *Anania amaniensis* (Maes, 1997) **comb. n.**, *Anania ankola* (Maes, 1997) **comb. n.**, *Anania bryalis* (Hampson, 1918) (*Lamprosema*) **comb. n.**, *Anania camerounensis* (Maes, 1997) **comb. n.**, *Anania elutalis* (Kenrick, 1917) (*Pyrausta*) **comb. n.**, *Anania epipaschialis* (Hampson, 1912) (*Nacoleia*) **comb. n.**, *Anania lippensi* (Maes, 1997) **comb. n.**, and *Anania ruwenzoriensis* (Maes, 1997) **comb. n.** In contrast, *Crypsitya* Meyrick, 1894 **stat. rev.** is reinstated as a valid taxon, based on our investigation of *Crypsitya coclesalis* (Walker, 1859: 701) (*Botys*) **comb. rev.**

Introduction

The Pyraustinae in the sense of Solis & Maes (2003) comprises about 1,400 species placed in 239 valid genera. According to morphological characters of the copulatory organs, the subfamily forms a rather uniform group. Their male terminalia do not bear a gnathos, but show a sella and an editum on the mesal wall of the valva and there are often deciduous cornuti on the vesica. Their female terminalia typically present an appendix bursae and a rhomboid signum in the wall of the corpus bursae. Additional pyraustine characters are given by Minet (1982) and Maes (1994). However, a cladistic analysis of crambid subfamilies showed only one synapomorphy for the Pyraustinae: a continuous median teguminal ridge forming two parallel lines (Solis & Maes 2003). Within the Pyraustinae, the generic classification is mainly based on traditional, typological views of wing pattern elements. Based on these studies, the group has been split into numerous genera, most of them containing less than five species.

In 2005, Leraut synonymized pyraustine genera *Algedonia* Lederer, 1863, *Ebulea* Doubleday, 1849, *Eurrhypara* Hübner, 1825, *Opsibotys* Warren, 1890, and *Perinephela* Hübner, 1825 with *Anania* Hübner, 1823. All these genera and the species included in them are well known to European lepidopterists (Goater 1986; Palm 1986; Karsholt & Razowski 1996). At first glance, the species formerly included in these genera do not look congeneric (Figs 1–8), but Leraut (2005) showed the common presence of a digitiform sclerotization in the female antrum (Figs 18–21), which seems to be related to the common presence of a spatulate-like sclerotization (“languette” sensu Leraut) in the phallic apodeme (Figs 13–17). He hypothesized that these structures are synapomorphies for the species he included in *Anania*.

Additionally, Leraut (2005) listed *Crypsitya* Meyrick, 1894 as a synonym of *Anania*. Then, he synonymized *Coclebotys* Munroe & Mutuura, 1969 with *Anania*, although *Coclebotys* had been already synonymized with *Crypsitya* by Shaffer et al. (1996: 189), which is supported by Maes (2002).

Though the digitiform sclerotization in the female antrum and the spatulate-like sclerotization of the phallus apodeme still deserve further investigation to clarify their function, we support the idea to group species that share common, homologous characters. Here we provide a morphological description of these characters and discuss their presence in additional pyraustines that have not been assigned to *Anania* before.

Material and Methods

Our investigation for the presence or absence of phallus sclerotization and the inner antrum digitiform structure involved pyraustine genera *Achyra* Guenée, 1849, *Anania* sensu Leraut (2005), *Callibotys* Munroe & Mutuura, 1969, *Carminibotys* Munroe & Mutuura, 1971, *Circobotys* Butler, 1879, *Crocidophora* Lederer, 1863, *Crypsitya*, *Demobotys* Munroe & Mutuura, 1969, *Ecpyrrhorhoe* Hübner, 1825, *Euclasta* Lederer, 1855, *Eumorphobotys* Munroe & Mutuura, 1969, *Gynenomus* Munroe & Mutuura, 1968, *Loxostege* Hübner, 1825, *Mimetebeulea* Munroe & Mutuura, 1968, *Nascia* Curtis, 1835, *Nephelobotys* Munroe & Mutuura, 1970, *Ostrinia* Hübner, 1825, *Paracorsia* Marion, 1959, *Paranomus* Munroe & Mutuura, 1968, *Paratalanta* Meyrick, 1890, *Parbattia* Moore, 1888, *Pronomus* Munroe & Mutuura, 1968, *Psammotus* Hübner, 1825, *Pseudebeulea* Butler, 1881, *Pyrausta* Schrank, 1802, *Sclerocona* Meyrick, 1890, *Tenerobotys* Munroe & Mutuura, 1971, *Thliptoceras* Warren in Swinhoe, 1890, *Udonomeiga* Mutuura, 1954, and *Uresiphita* Hübner, 1825.

Nomenclatural data were edited using the online database of the Global Information System on Pyraloidea (Nuss et al. 2009).

Genitalia were prepared and mounted according to the standards suggested by Robinson (1976). The genitalia of several additional specimens were investigated and their genitalia stored in microvials pinned on the specimens' pin. Images of the genitalia were taken using a NIKON Eclipse 600 microscope with a ZEISS AxioCam MRc5 digital camera.

The terminology follows Marion (1954, 1959), Kristensen (2003), and Nuss & Speidel (2005).

Abbreviations

AT	Andreas Tränkner
BMNH	Natural History Museum, London
MTD	Museum für Tierkunde Dresden
NKUM	Insect Collection, College of Life Sciences, Nankai University, Tianjin
prep. gen.	preparation of genitalia
TLMF	Tiroler Landesmuseum Ferdinandeum, Innsbruck
ZDD	Zhang Dandan
ZFMK	Zoologisches Forschungsinstitut und Museum Alexander Koenig, Bonn

Taxa currently treated in *Anania*

Leraut (2005) synonymized seven generic and subgeneric names with *Anania*. Unfortunately, he did not investigate all species-group taxa formerly treated in all of these genera and transferred only some of them to *Anania*. Thus, he established a confusing situation because a number of species-group taxa are left without generic combination. Here is an overview of the current synonymic situation:

- Anania* Hübner, 1823 d: 27. Type species: *Pyrallis guttalis* Denis & Schiffermüller, 1775.
- = *Algedonia* Lederer, 1863: 363. Type species: *Pyrallis luctualis* Hübner, 1796. Leraut 2005: 127 (syn.).
 - = *Mutuuraia* Munroe, 1976: 34–35. Type species: *Botys terrealis* Treitschke, 1829. Maes 2005: 74 (syn.).
 - = *Nealgedonia* Munroe, 1976: 32. Type species: *Botys extricalis* Guenée, 1854. Maes 2005: 74 (syn.).
 - = *Ebulea* Doubleday, 1849: 14. Type species: *Pyrallis crocealis* Hübner, 1796. Leraut 2005: 126 (syn.).
 - = *Ennychia* Treitschke, 1828: 318. Type species: *Phalaena octomaculata* Linnaeus, 1771. Guenée, 1854: 182. (syn.).
 - = *Eurrhypara* Hübner, 1825c: 360. Type species: *Phalaena urticata* Linnaeus, 1761. Leraut 2005: 129 (subgen.).
 - = *Proteurrhypara* Munroe & Mutuura, 1969a: 899–900. Type species: *Opsibotys ocellalis* Warren, 1892. Leraut 2005: 129 (syn.).
 - = *Opsibotys* Warren, 1890: 474. Type species: *Pyrallis fuscalis* Denis & Schiffermüller, 1775. Leraut 2005: 129 (subgen.).
 - = *Perinephela* Hübner, 1825c: 357. Type species: *Pyrallis lancealis* Denis & Schiffermüller, 1775. Leraut 2005: 126 (syn.).
 - = *Phlyctaenia* Hübner, 1825c: 359. Type species: *Pyrallis sambucalis* Denis & Schiffermüller, 1775. Leraut 2005: 126 (syn.).
 - = *Trichovalva* Amsel, 1956: 284. Type species: *Trichovalva ledereri* Amsel, 1956. Munroe 1995: 7, 54, 164 (syn.).

Palaeartic species of *Anania*

The following is a list of the Palaeartic species placed in *Anania* according to published records:

- Anania albeoverbasalis* Yamanaka, 1966: 32–33 pl. 1 figs 4, 8–8a. pl. 2 fig. 16. Type locality: Japan. Honshu, Toyama Prefecture, Kurobe, Keyakidaira.

- Anania chekiangensis* (Munroe & Mutuura, 1969 a: 900–902, figs 4, 10, 16) (*Proteurrhynpara*). Type locality: China, Zhejiang province, West Tianmushan. Leraut 2005: 129 (*Anania* (*Eurrhynpara*)).
- Anania coronata* (Hufnagel, 1767: 616, pl. 20 fig. 14) (*Phalaena*). Type locality: Europe. Leraut 2005: 127 (*Anania*).
- Anania crocealis* (Hübner, 1796 a: 13, 24, pl. 11 fig. 71) (*Pyrallis*). Type locality: Hungary. Leraut 2005: 125–127 fig. 5 (*Anania*).
- Anania egentalis* (Christoph, 1881: 19) (*Botys verbascalis* var.). Type locality: Russia, Amur region. Inoue 1988: 91 (*Anania*, sp.).
- Anania funebris* (Ström, 1768: 339, pl. 16 fig. 17) (*Phalaena*). Type locality: Norway. Pierce & Metcalfe 1938: 28, pl. 16 (*Anania*).
- Anania fuscalis* (Denis & Schiffermüller, 1775: 121) (*Pyrallis*). Type locality: [Austria] Wienergegend. Leraut 2005: 130 (*Anania* (*Opsibotys*)).
- Anania fuscobrunnealis* (South [in Leech], 1901: 498, pl. 15 fig. 7) (*Pyrausta*). Type locality: China, Hubei Province, Changyang. Leraut 2005: 130 (*Anania* (*Opsibotys*)).
- Anania fuscofulvalis* Yamanaka, 2000: 63, figs 1386–1388, 1394, pl. 163 fig. 13. Type locality: Nepal, Bagmati, Godavari.
- Anania hortulata* (Linnaeus, 1758: 529) (*Phalaena* (*Geometra*)). Type locality: Not stated. Leraut 2005: 125 fig. 4 (*Anania* (*Eurrhynpara*)).
- Anania lancealis* (Denis & Schiffermüller, 1775: 121) (*Pyrallis*). Type locality: [Austria] Wienergegend. Leraut 2005: 127 (*Anania*).
- Anania luctualis* (Hübner, 1796 a: 20, pl. 14 fig. 88) (*Pyrallis*). Type locality: Germany, Sachsen, Leipzig. Leraut 2005: 127 (*Anania*).
- Anania oberthuri* (Turati, 1913: 18) (*Botys* (*Sylepta*)). Type locality: Italy, Sardinia, Gennargentu. Leraut 2005: 127 (*Anania*).
- Anania ocellalis* (Warren, 1892: 295) (*Opsibotys*). Type locality: Japan. Leraut 2005: 129 (*Anania* (*Eurrhynpara*)).
- Anania occidentalis* (Munroe & Mutuura, 1969 a: 902–904, figs 5, 11, 17). (*Proteurrhynpara*). Type locality: China, Yunnan, Lijiang. Leraut 2005: 129 (*Anania* (*Eurrhynpara*)).
- Anania perlucidalis* (Hübner, 1800–1809 b: pl. 22 fig. 143) (*Pyrallis*). Type locality: Europe. Leraut 2005: 127 (*Anania*).
- Anania stachydalis* (Zincken [in Germar], 1821: 18, fig. 18) (*Pyrallis*). Leraut 2005: 127 (*Anania*).
- Anania terrealis* (Treitschke, 1829: 110–111) (*Botys*). Type locality: Croatia, Dalmatia. Leraut 2005: 125 (*Anania*).
- Anania testacealis* (Zeller, 1847: 571–572) (*Botys*). Type locality: Italy, Sicily, Syracuse, Acradina. Leraut 2005: 127 (*Anania*).
- Anania verbascalis* (Denis & Schiffermüller, 1775: 121) (*Pyrallis*). Type locality: [Austria] Wienergegend. Pierce & Metcalfe 1938: 28, pl. 16 (*Anania*).

There are four additional Palaearctic species formerly assigned to *Opsibotys* and *Algedonia*, but not yet transferred to *Anania*. We did not investigate these species, but their genitalia have been illustrated in the literature, which allows to associate them with *Anania*:

- Anania hasanensis* (Kirpichnikova, 1998: 312, figs 1–2), **comb. n.** (*Opsibotys*). Type locality: Russia, Primorske territory, Khasan district, Mayachnoe.
- Anania luteorubralis* (Caradja, 1916: 34–35), **comb. n.** (*Pyrausta*). Type locality: China, Xinjiang, Tian Shan. Juldus [= Kaidu He], Speidel & Hanigk 1990: 269–270, figs 17–18 (*Algedonia*).
- Anania obtusalis* (Yamanaka, 1987: 191–193 figs 1, 3), **comb. n.** (*Perinephela*). Type locality: Japan, Honshu.
- Anania shafferi* (Speidel & Hanigk, 1990: 270–271, figs 5, 10, 19–20), **comb. n.** (*Algedonia*). Type locality: Afghanistan, Gulmurg.

Anania species occurring outside the Palaearctic Region

The majority of *Anania* species occur outside of the Palaearctic Region (Munroe 1995; Maes 2003; Leraut 2005). However, due to the synonymisation of some genera with *Anania* by Leraut (2005), the correct number of valid species belonging to this genus still has to be verified. For example, there are a number of species provisionally placed in *Phlyctaenia* indicated as “misplaced” in Munroe (1995). Due to the synonymisation of *Phlyctaenia* with *Anania*, all these species formally belong to the latter genus, but their generic placement needs to be verified. Among them are *Pionea adiposalis* Dognin, 1912 and *Pionea teinopalpia* Hampson, 1913, which have been transferred to *Anania* by Leraut (2005), apparently without examination of the type specimens because these two species probably belong to the crambine genus *Erupa* Walker, 1864 (B. Landry, unpubl.). A complete synonymic catalogue of *Anania* species can be found in Nuss et al. (2009).

Taxonomic results

The type species of generic synonyms *Algedonia*, *Ebulea*, *Eurrhypara*, *Opsibotys*, *Perinephela*, and *Phlyctaenia* treated by Leraut (2005) in *Anania* as well as *Mutuuraia*, which was synonymized to *Algedonia* by Maes (2005), present male terminalia with a elongated, asymmetric sclerite of the phallus apodeme and female terminalia with a digitiform sclerotization inside the antrum. Among the taxa studied, we found these characters also in three species of *Pronomis*, two of *Tenerobotys*, and one of *Udonomeiga*.

Anania Hübner, 1823

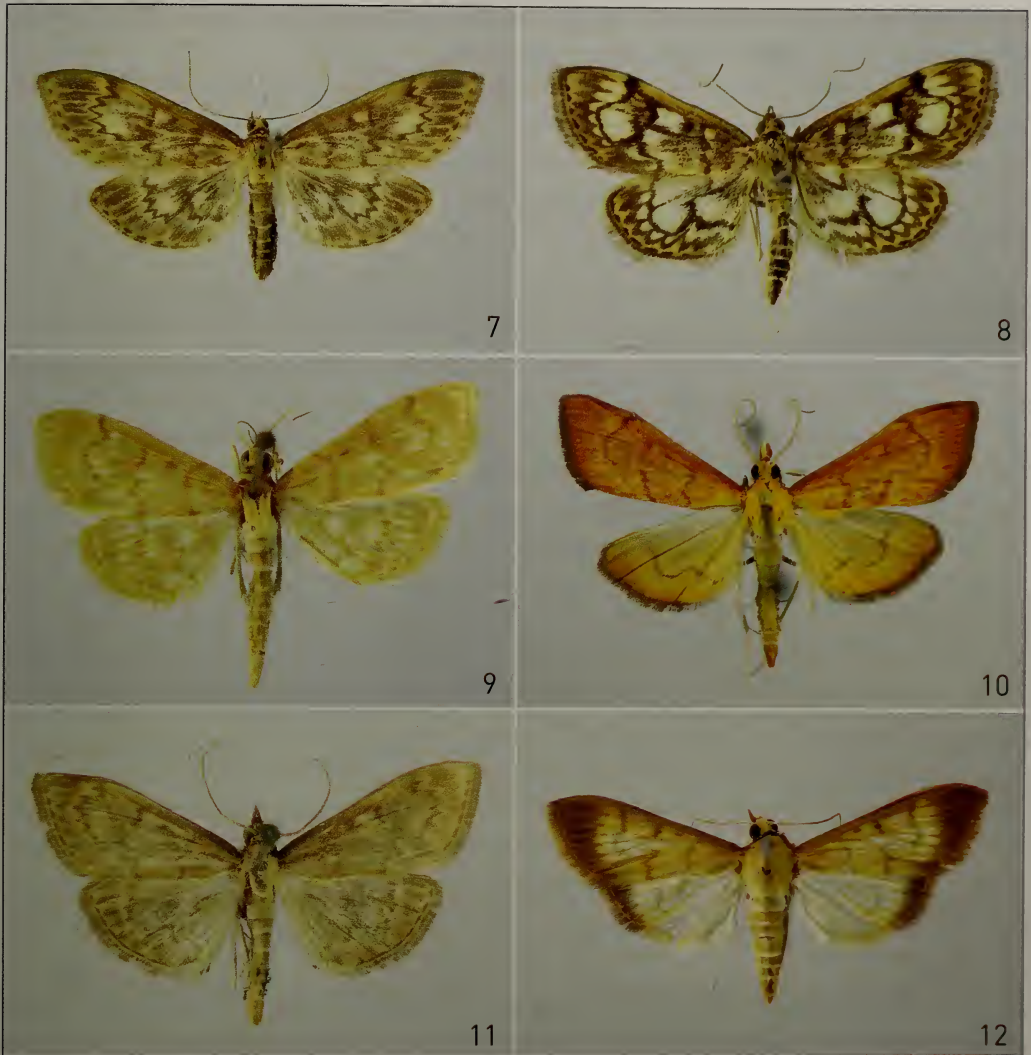
Anania Hübner, 1823 d: 27. Type species: *Phalaena octomaculata* Linnaeus, 1771.

Material. *A. funebris*: 1♂, Germany, Jena, 10.vi.1918, Ernst leg., prep. gen. AT53; 1♂, Austria, Kirchdorf, 1897, Hauder, coll. Wernicke via Kotsch, prep. gen. AT59; 1♂, Switzerland, Ober Engadin, 1910, W. Heinitz leg., prep. gen. AT62, MTD. 1♀, Italy, Bozen, 26.vii.1898, coll. Wernicke via Kotsch, prep. gen. AT61; 1♀, France, Digne Provence, vii.1908, prep. gen. AT52; 1♀, Austria, Kapruner Tal, vii.1942, E. Möbius, prep. gen. AT51; 1♀, Italy, South Tyrol, Klausen, 6.vi.1921, prep. gen. AT60, MTD. – *A. verbascalis*: 1♂, Switzerland, Stalden, Wallis, 20.v.1928, prep. gen. AT21; 1♀, same locality, 13.v.1928, prep. gen. AT20, MTD. – *A. terrealis*: 1♂, Germany, Loessnitz, Dresden, 20.iv.1907, prep. gen. AT33; 1♀, Germany, Meissen, leg. 1909, coll. E. Riedel, prep. gen. AT32, MTD. – *A. crocealis*: 1♂, Italy, Riva, 1911, W. Heinitz leg., prep. gen. AT19; 1♀, Italy, Mendel, 1913, W. Heinitz leg., prep. gen. AT18, MTD. – *A. hortulata*: 1♂, Germany, Sachsen, Radeberg, 11.vi.1963, prep. gen. AT38; 1♀, Germany, Dresden, Saubachtal, 29.v.1903, prep. gen. AT39, MTD. – *A. fuscalis*: 1♂, Germany, Dresden, 1990, prep. gen. AT8; 1♀, France, Alpes Maritimes, St. Martin-Vésubie, 18.vii.1914, prep. gen. AT7, MTD. – *A. lancealis*: 1♂, Germany, Chemnitz, vii.1908, prep. gen. AT29; 1♀, Germany, Dresden, Rabenauer Grund, vi.1909, prep. gen. AT28, MTD. – *A. coronata*: 1♂, Germany, Hintere Sächsische Schweiz, Großer Winterberg, 29.vi.1967, prep. gen. AT31; 1♀, Germany, Chemnitz, vii.1908, prep. gen. AT30, MTD.

Male terminalia. In *A. funebris* (Fig. 13) uncus long and small, distally pointed. Vinculum dorsally on each side with membrane adorned with loose-fitting brush of hair-like coremata slightly exceeding posterior tip of valva. Mesal wall of valva anteriorly with sella with sclerotized ventral border with small dents and process directed posteriorly. Editum with many dorsally directed lamellae. Sacculus posteriorly



Figs 1–6. Adults of European *Anania* species. 1. *A. funebris* (= *A. guttalis*, *A. octomaculata*) ♂, Germany, Chemnitz, 21.vii.1944, W. Heinitz leg. (MTD). 2. *A. luctualis* (formerly *Algedonia*), ♀, Germany, Schleibach (MTD). 3. *A. terrealis* (formerly *Algedonia*), ♀, Germany, Sachsen, Moritzburg, 25.vii.1967, Bembek & Krause leg. (MTD). 4. *A. crocealis* (formerly *Ebulea*), ♂, Switzerland, St. Gallen, 1891, Wernicke coll. (MTD). 5. *A. hortulata* (formerly *Eurrhapa*), ♂, Germany, Dresden-Wachwitz, 17.v.17, M. Koch leg. (MTD). 6. *A. fuscalis* (formerly *Opsibotys*), ♀, Germany, Dresden, Dippelsdorf, 5.vii.1941 (MTD).



Figs 7–12. Adults of European and Chinese species of *Anania* and *Crypsiptya*. **7.** *A. lancealis* (formerly *Perinephela*), ♀, Poland, Zabrze (“Hindenburg”), 10.vi.43 coll. Ernst Limbach (MTD). **8.** *A. coronata* (formerly *Phlyctaenia*), ♂, Germany, Radebeul-Kötzschenbroda, 1934, E. Möbius coll. (MTD). **9.** *A. delicatalis* (formerly *Pronomis*), ♂, Zhejiang Province, West Tianmushan, 15.v.1932, H. Höne (ZFMK). **10.** *A. teneralis* (formerly *Tenerobotys*), ♂, Inner Mongolia, Motezuqi, Chasuqi, 950 m, 11.viii.2002, Dandan Zhang & Zhiqiang Li leg. (NKUM). **11.** *A. vicinalis* (formerly *Udonomeiga*), ♂, Zhejiang Province, Tianmushan, 29.v.1931, H. Höne (ZFMK). **12.** *C. coclesalis*, ♀, Hainan Province, Wanning, Xingzhong Farm, 110 m, 3.viii.2008, Bingbing Hu & Li Zhang leg., prep. gen. AT67 (NKUM).

with long spine directed dorsally. Mesal wall of valva densely covered with hair-like setae. Juxta U-shaped, deeply notched posteriorly.

Anellus attached along posterior third of phallus, but latter entirely anterior to diaphragma. Entrance of ductus ejaculatorius to phallus situated anterodorsally. Apodeme of praephallus strongly reduced to one lateral spine-like extension directed posteriorly. Conspicuously elongate sclerite attached to inner wall of phallic apodeme, ventrad of spine-like extension; sclerite ("languette" sensu Leraut) slightly constricted medially and reaching posterior end of phallus, asymmetrically enlarged at apex and with serrated edges. Vesica without cornuti. Phallus apodeme varying in form and size from an elongate sclerite in *A. funebris* (Fig. 13) to a deeply cleft sclerite in *A. lancealis* (Fig. 14) and *A. fuscalis*; in both cases lobes more or less serrated and concave in cross-section in correlation with cylindrical shape of phallus.

Female terminalia. In *A. funebris* (Fig. 18), appendix bursae anteriorly situated and with rhomboid signum on corpus bursae. Ductus bursae membranous, thin and long, with various folds and loops. Insertion of ductus seminalis situated fairly posterad along ductus bursae. Colliculum small and short, followed directly by antrum, showing specialized sclerotizations. Antrum sac-like, enlarged, with free digitiform sclerotization extending up to posterior edge. In diameter, anterior part of digitiform structure slightly larger than posterior end of ductus bursae. Ostium bursae situated ventro-anteriorly on digitiform structure. Lamella postvaginalis situated dorso-posteriorly in relation to antrum; its sclerotization extending ventrally towards segment VIII. Ostium situated ventro-posteriorly on digitiform structure in *A. verbascalis*, posteriorly in *A. crocealis*.

Pronomis Munroe & Mutuura, 1968, **syn. n.**

Pronomis Munroe & Mutuura, 1968: 986–987, figs 1, 20, 25. Type species: *Pyrausta delicatalis* South, 1901, by original designation.

Material. *A. delicatalis* **comb. n.**: **China**, 2♂, 1♀, Zhejiang Province, Tianmushan, Chanyuansi, 310 m, 15.viii.1999, leg. Houhun Li et al., prep. gen. ZDD02073, 02140, 02141; 1♂, Guangxi Zhuang Autonomous Region, Guilin, Maershan, Jiuniutang, 1100 m, 9.iv.2002, leg. Shulian Hao & Huaijun Xue, prep. gen. ZDD02244, NKUM. 1♂, Sichuan, Kangding (= Tatsienlu, Ta-Chien-Lu), 8300 ft, vii–viii.1890, Pyralidae Brit. Mus. Slide No. 17372; 1♀, Moupin, viii.1890, Pyralidae Brit. Mus. Slide No. 17373, BMNH. 1♂, 1♀, Zhejiang Province, West Tianmushan, 15.v., 17.vi.1932, leg. H. Höne, gen. prep. AT65, ZFMK.

Anania delicatalis **comb. n.** (Fig. 9) presents the typical characters regarded as synapomorphic for *Anania*, but phallus apodeme with undivided sclerite of 2/3 length of phallus, apex of sclerite straight, truncated, slightly serrated, with asymmetrical lateral enlargement (Fig. 15). Vesica with deciduous cornuti as long as 1/3 phallus length, with dentate edges. Digitiform structure of females nearly as long as antrum, similar to open cylinder with ostium located at blunt posterior tip; antrum strongly sclerotized, nearly as long as broad and strongly swollen dorsally, with four folds on each side and many small spines (Fig. 19).

Species formerly placed in *Pronomis*:

Anania delicatalis (South [in Leech], 1901: 499, pl. 15 fig. 27) **comb. n.** (*Pyrausta*). Type locality: China. Munroe & Mutuura, 1968: 986 (*Pronomis*).

Anania flavicolor (Munroe & Mutuura, 1968: 987–988, figs 1, 12) **comb. n.** (*Pronomis*). Type locality: China, Taiwan, Takow.

Anania profusalis (Warren, 1896: 95) **comb. n.** (*Opsibotys*). Type locality: India, Khasia Hills. Munroe & Mutuura 1968: 987 (*Pronomis*).

Tenerobotys Munroe & Mutuura, 1971, **syn. n.**

Tenerobotys Munroe & Mutuura, 1971: 174. Type species: *Hapalia teneralis* Caradja, 1939.

Material. *A. subfumalis* **comb. n.**: **China**, 1♂, Hunan Province, Zhuzhou, vi.1965, prep. gen. ZDD02344; 1♂, 1♀, Henan Province, Xinyang, Jigongshan, 700 m, 13.vii.2001, leg. Dandan Zhang, prep. gen. ZDD02065, 02064; 1♀, Henan Province, Tongbai, Shuiliandong, 300 m, 16.vii.2001, leg. Dandan Zhang, prep. gen. AT08034, NKUM. – *A. teneralis* **comb. n.**: **China**, 1♂, Hebei Province, Yi County, West Mausoleum of the Qing Dynasty, 100 m, 18.vii.2000, leg. Haili Yu, prep. gen. ZDD01224; 1♂, Sichuan Province, Batang, Zhubalong, 2500 m, 10.vii.2001, leg. Houhun Li & Xinpu Wang, prep. gen. ZDD02160; 1♂, Qinghai Province, Xunhua, Mengda, 2240 m, 15.vii.1995, Houhun Li & Shuxia Wang, prep. gen. ZDD02069; 1♂, Inner Mongolia, Motezuqi, Chasuqi, 950 m, 11.viii.2002, leg. Dandan Zhang & Zhiqiang Li, prep. gen. ZDD02341; 1♂, Qinghai Province, Xunhua, Mengda, 2240 m, 13.vii.1995, leg. Houhun Li & Shuxia Wang, prep. gen. AT08008; 3♀, Sichuan Province, Batang, Zhubalong, 2500 m, 10.vii.2001, leg. Houhun Li & Xinpu Wang, prep. gen. ZDD01840, AT08009; Inner Mongolia, Motezuqi, Chasuqi, 950 m, 11.viii.2002, leg. Dandan Zhang & Zhiqiang Li, prep. gen. AT08007, NKUM.

Anania teneralis **comb. n.** (Fig. 10), presents the typical characters regarded as synapomorphic for *Anania*, but phallus short and thick, with conspicuously undivided sclerite half as long as phallus length and not constricted, with apex rounded and serrated. Prephallus apodeme asymmetrically reduced as in *A. funebris*, forming only concave tongue opposite sclerite (Fig. 16). Deciduous cornuti as long as 1/3 phallus length and not serrated. Digitiform structure of females short and broad, with moderate conical tip. Ostium situated ventro-anteriorly as in *A. funebris*. Antrum broader than long. Bursa copulatrix with asymmetrical signum (Fig. 20).

Species formerly placed in *Tenerobotys*:

Anania subfumalis (Munroe & Mutuura, 1971: 177–178, figs 4–5, 12, 16) **comb. n.** (*Tenerobotys*). Type locality: China, Taiwan, Nan Tou Hsien, Hori (Puli), Wanta.

= *Anania subfumalis continentalis* (Munroe & Mutuura, 1971: 178, figs 6–7, 13, 17) **comb. n.** (*Tenerobotys*). Type locality: China, Province of Hunan, Hoengshan.

Anania teneralis (Caradja, 1939: 23) **comb. n.** (*Hapalia*). Type locality: China, Sichuan, Batang, 2800 m. Munroe & Mutuura, 1971: 174 (*Tenerobotys*).

= *Anania teneralis tsinlingalis* (Munroe & Mutuura, 1971: 176, figs 2–3, 11, 15) **comb. n.** (*Tenerobotys*). Type locality: China, Shaanxi Province, Tsinling, Tapaishan.

Udonomeiga Mutuura, 1954, **syn. n.**

Udonomeiga Mutuura, 1954: 18. Type species: *Pyrausta vicinalis* South, 1901.

Material. *A. vicinalis* **comb. n.**: **China**, 2♂, Guizhou Province, Chishui, Suoluo, 240 m, 21.ix.2000, leg. Haili Yu, prep. gen. ZDD02153, 02157, NKUM. 1♂, Zhejiang Province, Tianmushan 29.v.1931, Höne, prep. gen. AT64, ZFMK. **Korea**, 1♀, Utikongo, im Kongosan, 500m, 25.vii.1940, H. Höne leg., prep. gen. AT63, ZFMK.

Anania vicinalis **comb. n.** (Fig. 11) presents the typical characters regarded as synapomorphic for *Anania*, but entrance of ductus ejaculatorius in phallus situated anterio-laterally on right side. Conspicuous phallus sclerite deeply cleft, smaller lobe situated on same side as entrance of ductus ejaculatorius, bigger lobe situated on opposite side;

two lobes constricted and serrated towards broadened tips (Fig. 17). Vesica with deciduous cornuti half as long as phallus diameter and with small thorns. Ductus bursae membranous with 9–10 loops and with spirally sclerotized band towards corpus bursae. Digitiform structure extending beyond posterior edge of antrum, enclosing it narrowly. Ostium bursae situated ventro-posteriorly on digitiform structure. Lamella postvaginalis stretching dorso-posteriorly from antrum (Fig. 21).

Species formerly placed in *Udonomeiga*:

Anania vicinalis (South [in Leech], 1901: 502, pl. 15 fig. 30) **comb. n.** (*Pyrausta*). Type locality: China.

Ethiobotys Maes, 1997, **syn. n.**

Ethiobotys Maes, 1997: 390–392. Type species: *Lamprosema bryalis* Hampson, 1918.

According to the original description by Maes (1997), this taxon presents the characters that are apomorphic for *Anania*. We did not investigate the eight included species, but their genitalia are sufficiently described and figured in the original descriptions, illustrating the presence of the asymmetric sclerite of the praepallus and the digitiform structure in the antrum. Thus, *Ethiobotys* is synonymized with *Anania* and the species formerly treated in *Ethiobotys* are transferred to *Anania*.

Species formerly placed in *Ethiobotys*:

Anania amaniensis (Maes, 1997: 399–401, pl. 1 fig. 3, pl. 3 fig. a, pl. 4 fig. a), **comb. n.** Type locality: Tanzania, Amani.

Anania ankoleae (Maes, 1997: 398–399, pl. 1 fig. 8, pl. 3 fig. c), **comb. n.** Type locality: Uganda, Ankole, Falinzu forest.

Anania bryalis (Hampson, 1918: 136) (*Lamprosema*), **comb. n.** Type locality: Kenya, N. Kavirondo.

Anania camerounensis (Maes, 1997: 401, pl. 1 fig. 4, pl. 3 fig. b, pl. 4 fig. b), **comb. n.** Type locality: Cameroon, Mt. Cameroon Bonakanda.

Anania elutalis (Kenrick, 1917: 100, pl. 6) (*Pyrausta*), **comb. n.** Type locality: Madagascar.

Anania epipaschialis (Hampson, 1912: 439) (*Nacoleia*), **comb. n.** Type locality: Sierra Leone.

Anania lippensi (Maes, 1997: 396–398, pl. 1 fig. 2, pl. 3 fig. d, pl. 4 fig. c), **comb. n.** Type locality: Cameroon, S.W. Bonakanda 1325m.

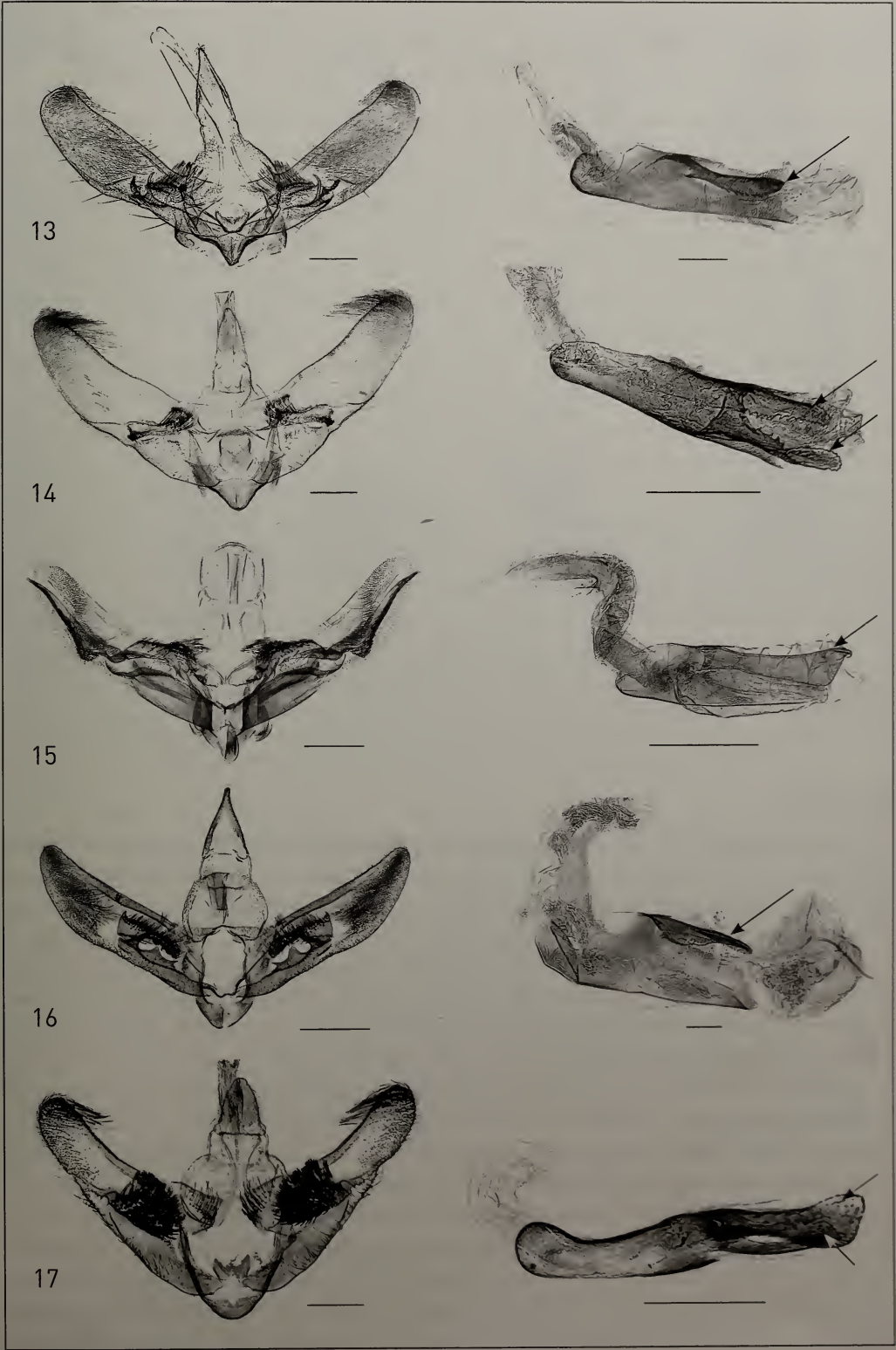
Anania ruwenzoriensis (Maes, 1997: 394, pl. 1 fig. 7; pl. 2 fig. b), **comb. n.** Type locality: Uganda, Ruwenzori, 6500–7500ft.

Crypsitya Meyrick, 1894, **stat. rev.**

Crypsitya Meyrick, 1894: 463. Type species: *Botys nereidalis* Lederer, 1863.

= *Coclebotys* Munroe & Mutuura, 1969 b: 1243–1245. Type species: *Botys coclesalis* Walker, 1859. Shaffer et al. 1996: 189 (syn.).

Figs 13–17. Male copulatory organs of *Anania* species (scale bars 500 µm). **13.** *A. funebris*, Austria, Kirchdorf, 1897. Hauder, coll. Wernicke, prep. gen. AT59 (MTD). **14.** *A. lancealis*, Germany, Chemnitz, vii.1908, prep. gen. AT29 (MTD). **15.** *A. delicatalis*, China, Sichuan, Kangding (= Tatsienlu, Ta-Chien-Lu), 8300 ft., vii.–viii.1890, prep. gen. 17372 (BMNH). **16.** *A. teneralis*, China, Qinghai Province, Xunhua, Mengda, 2240 m, 13.vii.1995. Houhun Li & Shuxia Wang leg., prep. gen. AT08008 (NKUM). **17.** *A. vicinalis*, China, Zhejiang Province, Tianmushan, 29.v.1931. Höne leg., prep. gen. AT64 (ZFMK).



Material. *C. coclesalis*: **China**, 1♂, Hainan province, Wanning, Jianfeng Ling, Beidazheng Primary school, 110 m, 28.vii.2008, Bingbing Hu & Li Zhang, leg., prep. gen. AT58; 3♀, Hainan province, Wanning, Xingzhong Farm, 110 m, 3., 8.viii.2008, Bingbing Hu & Li Zhang leg., prep. gen. AT57, 67; 1♀, Henan Province, Tongbai, Shuiliandong, 300 m, 26.vii.2000, leg. Haili Yu, prep. gen. AT08011, NKUM.

In *Crypsiptya coclesalis* (Fig. 12), phallus apodeme elongated shoehorn-shaped with acuminate curved tip. This distal process constricted at end of phallus apodeme and seamless extension of phallus sclerotization. Small thorn curved anteriorly, situated at base of distal process (Fig. 22). Colliculum of females elongate and strongly sclerotized, folded longitudinally. Inside colliculum blunt ending sclerotized tube as broad as antrum (Fig. 23). In dorsal view, tube very flat and hard to identify as hollow structure; dorsally and ventrally fixed to colliculum wall. Ostium situated at posterior most tip of tube, situated in anterior part of antrum sac.

Leraut (2005: 127) listed *Crypsiptya* Meyrick, 1894 as a synonym of *Anania* and mentioned by mistake that the synonymy was established by Shaffer et al. (1996), who in fact treated *Crypsiptya* as a valid genus. In addition, Leraut (2005) synonymized *Coclebotys* Munroe & Mutuura, 1969 with *Anania*, although *Coclebotys* had been already synonymized with *Crypsiptya* by Shaffer et al. (1996: 189). Here, we reinstate *Crypsiptya* as a valid genus following Shaffer et al. (1996), as well as Maes (2002), who provides a world checklist of *Crypsiptya*. Also, our investigation of the bamboo leaf roller *Crypsiptya coclesalis* from China shows that the structures of the terminalia that are apomorphic to *Anania* are not present in *Crypsiptya*. We were not able to study the type of *Crypsiptya nereidalis*, likely kept at the BMNH, but we do not doubt the conclusions of Shaffer et al. (1996), as well as Maes (2002) about the synonymy of *Coclebotys* with *Crypsiptya*.

Discussion

Our investigations of Pyraustinae confirm the unique characters of the male and female copulatory organs in *Anania*, as shown by Leraut (2005). In males, the apodeme of the praephallus is asymmetrically sclerotized and a conspicuously elongated sclerite ("languette" sensu Leraut) is present. In females, the antrum typically bears a digitiform structure fixed to its anterior wall, enclosing the opening of the ductus bursae into the antrum, and extending freely into the antrum sac. The ostium is translocated to the digitiform structure and its position and shape vary between species. The common presence and complexity of this structure suggests its homology among species. Since we do not know any other pyraloid taxon possessing these structures, we argue in conformity with Leraut (2005) that they are apomorphic for *Anania*.

The male and female structures identified to represent synapomorphies for *Anania* have been repeatedly studied and figured, e.g. by Mutuura (1954), Inoue (1960), and Yamanaka (1987). Speidel & Hanigk (1990) used the shape of the male phallus sclerites to discriminate *Algedonia* and *Mutuuraia* as subgenera of *Algedonia*. Munroe & Mutuura (1969a) characterized *Proteurrhypara* based on the shape of the phallic sclerites. In 2005, Maes listed a group of genera sharing the common presence of these structures in male and female genitalia. In the same year, Leraut synonymized some



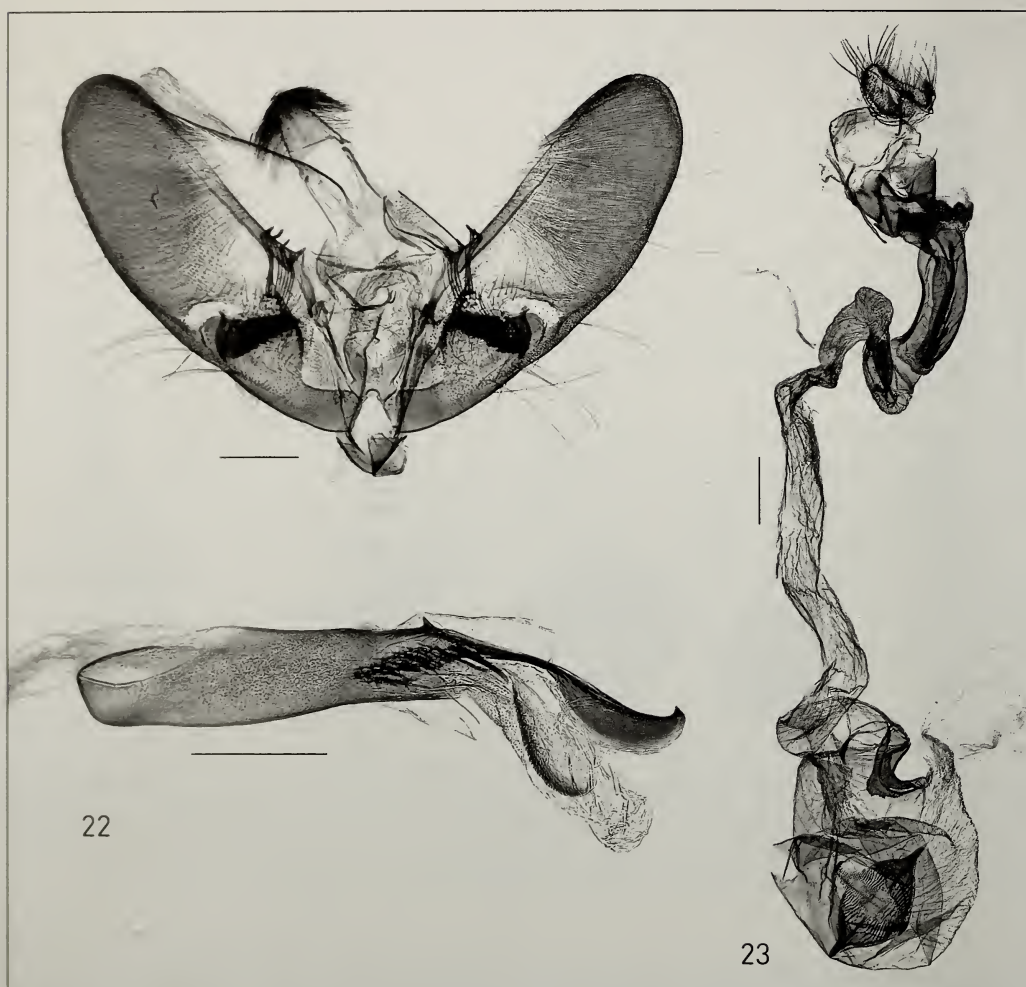
Figs 18–21. Female copulatory organs of *Anania* species; arrows pointing to digitiform structure (scale bars 500 μ m). **18.** *A. funebris*, Austria, Klausen, Tirol, 6.vi.1921, prep. gen. AT60 (MTD). **19.** *A. delicatalis*, China, Moupin, viii.1890, prep. gen. 17373 (BMNH). **20.** *A. teneralis*, China, Sichuan Province, Batang, Zhubalong, 2500 m, 10.vii.2001, Houhun Li & Xipu Wang leg., prep. gen. AT08009 (NKUM). **21.** *A. vicinalis*, Korea, Utikongo, Kongosan, 500 m, 25.vii.1940. H. Höne leg., prep. gen. AT63 (ZFMK).

of these genera with *Anania*, based on the common presence of the same characters mentioned by Maes.

In contrast to Leraut (2005), *Crypsiptya* is regarded here as distinct from *Anania* because of the different characters of the copulatory organs. The tubular structure inside the colliculum of *Crypsiptya* can be confused with the digitiform structure in the antrum of *Anania*, but they are not regarded here as homologous as they are in different positions. Furthermore, it is questionable whether the phallic extension of *Crypsiptya* is homologous to the elongated sclerite of the phallus in *Anania* because the phallic extension of *Crypsiptya* is neither serrated nor distinctly sclerotized as in *Anania*.

The genitalia synapomorphies of *Anania* are found to be present in the three Chinese genera synonymized here. Despite the very strong swollen antrum of the species formerly treated in *Pronomis*, the digitiform structure and the asymmetric phallus apodeme can be clearly identified. Maes (2005) already mentioned that *Pronomis* shares the *Anania* characters we are now regarding as synapomorphies, but did not translate this into nomenclatural acts.

These characters are also present in the species of *Ethioborys*, which was basically characterized by the dilated male antennae and dilated male mid tibia (Maes 1997).



Figs 22–23. Copulatory organs of *Crypsitya coclesalis* (scale bars 500 μ m). 22. σ Hainan province, Wanning, Jianfeng Ling, Beidazheng Primary school, 110 m, 28.vii.2008, Bingbing Hu & Li Zhang, leg., prep. gen. AT58 (NKUM). 23. φ , China, Henan Province, Tongbai, Shuiliandong, 300 m, 26.vii.2000, Haili Yu leg., prep. gen. AT08011 (NKUM).

However, the dilated antennae are not synapomorphic for *Ethiobotys* because only *E. ankolae* shows this trait. The dilated mid tibia is not restricted to the afrotropical species placed in *Ethiobotys* as it is also present in males of the Chinese *Pronomis* (Munroe & Mutuura 1968). Thus, *Ethiobotys* clearly belongs to the ingroup of *Anania*.

Special traits are present in the genitalia of *Pronomis*, such as an asymmetrical signum of the corpus bursae (Fig. 19) and a strongly extended dent of the sella. However, the asymmetrical signum is also present in species formerly placed in *Tenerobotys* (Fig. 20, Munroe & Mutuura 1971). As these two taxa clearly present characters which allow to hypothesise their relationship within *Anania*, we prefer to lump them in order to obtain a monophyletic genus.

Though the nomenclatural changes introduced by Leraut (2005), which are largely supported in this paper, may upset the non-specialist, we argue in favour of the necessity to implement them in order to move to a natural generic classification of Pyraustinae. Also, it is our opinion that a large genus *Anania*, currently comprising 110 species, will provide more stability in the long term as the phylogenetic relationships between species still needs to be investigated. In our view, this procedure can help to revise the diversity of a species-rich group like Pyraustinae, containing approximately 1,400 species, currently still classified into 239 genera (Nuss et al. 2009). Regarding the fact that there are pyraustine genera containing several species like *Achyra* Guenée, 1849, *Hahncappsia* Munroe, 1976, *Loxostege* Hübner, 1825 and *Ostrinia* Hübner, 1825, or the very species-rich genus *Pyrausta* Schrank, 1802, the majority of the genera contain less than four species only. Because of the high number of species and genera within Pyraustinae, the analysis of their phylogeny will take a long time still. We regard the hypothesis of the monophyly of *Anania* just as one step towards the reconstruction of the natural relationships of pyraustine lineages that we have undertaken and that will be submitted to phylogenetic analysis.

In the future, the generic combination of the species provisionally assigned to *Anania* should be checked. A fascinating task remains in the study of the functional morphology of the copulatory organs of *Anania* species and their possible importance for speciation.

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