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Diasemiopsis ramburialis (Duponchel) (Lepidoptera, Pyralidae *s. l.*, Spilomelinae) in Iran: first record for the country and first host plant report on water fern (*Azolla filiculoides* Lam., Azollaceae)

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Abstract. During a survey at the Rice Research Institute of Iran (RRII, Rasht, Guilan) for potential biocontrol agents of water fern, *Azolla filiculoides* Lam. (Pteridophyta: Azollaceae), larvae of *Diasemiopsis ramburialis* (Duponchel) (Pyralidae *s. l.*, Spilomelinae) were discovered feeding on water fern. Larvae were found to cause serious feeding damage on leaves of water fern in the laboratory. The biology, life cycle, and the morphology of all stages of this species are described and illustrated for the first time. This is also the first record of this cosmopolitan species in Iran. We report water fern as a host for *Diasemiopsis ramburialis*; until now the host plant of *D. ramburialis* was unknown.

Introduction

Diasemiopsis ramburialis (Duponchel) is a snout moth in the subfamily Spilomelinae, the most species-diverse subfamily of Pyralidae *sensu lato* (or Crambidae, depending on authors, see Regier et al. 2012). Diagnostic characters for this subfamily are: head without chaetosemata, male hindwing without subcostal retinaculum, tympanal organs with a bilobed praecinctorium, projecting fornix tympani, and pointed spinula, male genitalia without gnathos, and corpus bursae of female genitalia usually without rhomboid signum (Minet 1982; Regier et al. 2012).

Diasemiopsis was described by Munroe (1957) with *Hydrocampa ramburialis* Duponchel, 1833 as type species. Only one other species, *D. leodocusalis* (Walker, 1859), described from the United States of America, is currently assigned to this genus (Nuss et al. 2015). The full synonymy of *D. ramburialis* is given by Nuss et al. (2015).

Adults of *D. ramburialis* are grey or brown, with two broad zigzagging white lines across each wing. They measure 17–22 mm in wingspan (n=20) (Fig. 1). Described from France (Corsica), this species has been reported from Africa (e.g. Maes 2004), the Seychelles (Aldabra Atoll) (Shaffer and Munroe 2007), Réunion (Guillermet 2009), Europe (Karsholt and Nieukerken 2013), Puerto Rico (Möschler 1890; Schaus 1940; Patterson 2015), Austral Islands (Rapa) (Clarke 1971), French Polynesia (Tahiti) (Oboyski 2015), Australia (Shaffer et al. 1996), Taiwan (Wang and Speidel 2000), and India (Kirti and Sodhi 2001). Clarke (1971) reported it as a cosmopolitan species and illustrated the habitus and male and female genitalia (see also Guillermet (2009) and Slamka (2013) for additional illustrations). Regarding records from the New World, Munroe (1957) mentioned

Figure 1. Adult of *Diasemiopsis ramburialis*.

that they actually refer to *D. leodocusalis* (Walker). Maes (2004) added that the species seemed to be linked to swampy areas. There is no record of host plant or any description of the immature stages available for *D. ramburialis*.

Azolla filiculoides Lam. (Azollaceae) is considered a major aquatic weed in several countries (Zimmerman 1985). It is a small-leafed floating aquatic fern native to the tropics, subtropics, and warm temperate regions of Africa, Asia, and the Americas (Costa et al. 2009). It is one of the world's fastest growing aquatic macrophytes, with a doubling time of only 2–5 days in biomass (Zimmerman 1985; Taghi-Ganjiet al. 2005). Some species of *Azolla* provide various benefits such as a source of organic nitrogen, soil improvement and nutrient availability, weed suppression, and as food for livestock, chicken, ducks and fishes (Anonymous 1987; Ferentinos et al. 2002). However, some of them, *A. pinnata* (R. Br.) and *A. filiculoides* in particular (e.g. Barreto et al. 2000), are considered major weeds in South Africa, Europe, and New Zealand (Hill 2003; Bodle 2008; Sadeghi et al. 2013) and *A. filiculoides* is an alien species in Iran (JICA 2005; Delnavaz and Azimi 2009).

In Iran, this weed invades rice fields and aquatic natural habitats, such as the Anzali (Delnavaz and Azimi 2009; Sadeghi et al. 2013) and Amir-kelayeh wetlands (Fig. 2) of the Guilan province. These wetlands have ecological importance for breeding, wintering, and survival of many species of birds, fish, and microorganisms (Khoshechin 1993; Naddafi et al. 2005; Charkhabi and Sakizadeh 2006; Moradinasab et al. 2012). Infestations of *A. filiculoides* reduce the quality of the water used for agricultural and human use, and simplify local aquatic food webs (Hill 1998). Control options for the water fern in Iran are limited because mechanical methods are impractical and there are no registered herbicides for aquatic ecosystems. This situation stimulated the use of biological control as a sustainable strategy for the long term management of *A. filiculoides* (Richerson and Grigarick 1967; McConnachie et al. 2003). *Stenopelmus rufinasus* Gyllenhal (Coleoptera: Curculionidae), a weevil native to the USA, had a huge impact on *A. filiculoides* as a biological control agent. This weevil controlled water fern in Africa, USA, and other regions (Hill et al. 2008; Partt

Figure 2. A waterway near Amir-kelayeh wetland covered with water fern.

et al. 2013). However, the identification of other active herbivores on *Azolla* as biotic resistance factors and competitor species with the main biological control agent was found to be desirable because other species may have negative or positive effects on the establishment of the main biological control agent. We conducted surveys in rice fields for two years due to a lack of information on local herbivores attacking *A. filiculoides* in Iran. The specific objective of this paper is to report the life history of *D. ramburialis* attacking *A. filiculoides* in Iran.

Material and methods

Rearing: Laboratory colonies were established by collecting larvae from water fern located on waterways and experimental rice fields at the Rice Research Institute of Iran (RRII) (N37°12’22.2”, E049°38’40.7”, 80 masl) from September to November 2013 and 2014.

Larvae were kept in 14 cm diameter petri dishes filled with water fern and 100 cc of distilled water. Petri dishes of the same size were used to cover the dishes to provide more space for larvae and newly emerged adults. Water was changed every 4 days and water fern was added if needed. The petri dishes were changed every 10 days to prevent the growth of fungi and bacteria.

Upon emergence, a pair, a male and female, were released into 14 cm covered petri dishes. To provide more space for the moths, we set up three 6 cm petri dishes each filled with 10 cc of distilled water and 5 g of water fern. The 6 cm petri dishes were changed daily and placed in an incubator until egg hatching. The incubator was set at 25–27 °C and 16: 8h (L: D) photoperiod. Thereafter, first or second instar larvae were placed in 6 cm petri dishes provided with 10 cc of water and 5 g of water fern in groups of one, two, and three individuals in each dish. Since the lar-

vae had wandering habits, each 6 cm petri dish was placed in a 14 cm covered petri dish. The 6 cm petri dishes were changed every three days and water fern was added if necessary. Moth colonies were inspected daily and all activities, including egg hatching, larval feeding period, pupation, and emergence of adults were recorded.

Identification: Twenty adults were used for preliminary identification based on wing venation and other morphological characters. Dissection of both male and female genitalia (Figs 7–9), were made following Landry (2003) and Lee and Brown (2009). Dissections were conducted at the RRII laboratory and sent to B. Landry for final determination. The specimens were identified as *Diasemiopsis ramburialis* (Duponchel, 1834).

Field observations: During 2013 and 2014, feeding damage observations by *D. ramburialis* on water fern and other potential host plants were conducted in the waterways and experimental rice fields located at RRII.

Results

Eggs: About 1 mm in diameter, globular, opaque to pale orange (Fig. 3), they turn to dark orange or reddish brown before hatching. They are laid singly or in groups of two or three on water fern leaves or smooth surfaces of other material (Petri dishes) near the food plant. Development time at 25–27 °C was approximately 4 days.

Larva: Newly hatched larvae are dark orange to reddish brown with a black head (Fig. 4), about 1.5 mm in length, and have sparse setae on the body. As the larva develops, its colour becomes darker, the setae increase in length, and dark spots appear at the base of the setae. The last instar larva is greenish brown (Fig. 5) and about 18 mm in length. There are black plates on each thoracic and abdominal segment. The prothoracic shield is pigmented laterally and unpigmented medially and there are four dorsal, two lateral, and two ventral pinacula on the meso- and metathorax. On abdominal segments I–VII there are four dorsal, two lateral, and two ventral pinacula on each segment. On abdominal segment VIII there are three dorsal pinacula in a triangular pattern of two rows: two pinacula in first row and one in second row; this segment has two lateral and two ventral pinacula as well. Abdominal segments IX and X respectively have one dorsal pinaculum and one dorsal and one lateral pinaculum. There is little space between these pinacula and these areas appear as three longitudinal bands. The development time of 100 larvae at 25–27 °C was 14 to 15 days.

Pupa: Pupation usually occurred on dried water fern or mud on the side of the dishes. The length of pupa is approximately 7–9 mm and the colour turns from yellowish brown to dark brown during development (Fig. 6). The development time of 50 pupae at 25–27 °C was 7 days.

Adults: The habitus and male and female genitalia are illustrated in Figs 1 and 7–9. The longevity of adults at 25–27 °C with and without a sugary solution (10% honey) was <30 days and 14 days, respectively (at least 30 adults were followed under each treatment).

Symptoms of damage on host plants: Larvae of *D. ramburialis* are phyllophagous. We have observed that newly hatched larvae build shelters by binding leaves together with silk and remain hidden in their shelters when they are not actively feeding. When larvae mature, they leave their shelter and wander on water fern leaves in silky tunnels filled with frass (Figs 10 and 11). Feeding damage by larvae facilitated the infection of water fern with bacteria and fungi. Egg laying occurred during the entire lifetime (ca. 30 days) and the number of eggs per day varied considerably.

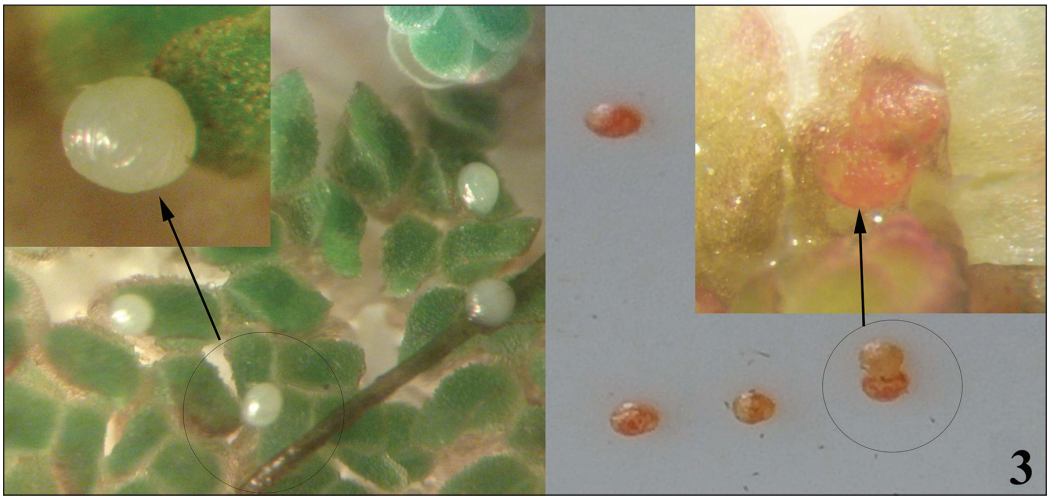
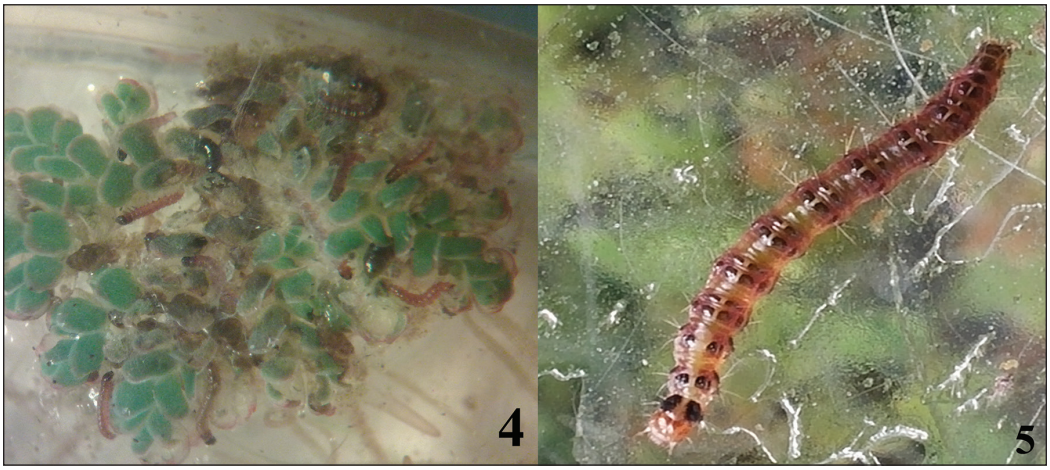


Figure 3. *Diasemiopsis ramburialis* eggs (Right: Infertile, Left: Fertile).



Figures 4, 5. *Diasemiopsis ramburialis* larvae **4.** First instar, **5.** Last instar.

Discussion

In northern regions of Iran, aquatic ecosystems such as stagnant waters, ponds, ditches, canals or paddy fields may be covered seasonally by *Azolla* (Delnavaz and Azimi 2009; Sadeghi et al. 2013) in association with other floating aquatic plants including *Lemna minor* L. (duckweed: Lemnaceae), *Trapa* sp. (water caltrop: Trapaceae), *Wolffia* sp. (water meal: Lemnaceae), or *Salvinia* sp. (Salviniaceae), and mud-rooting species such as *Ceratophyllum demersum* L. (hornwort: Ceratophyllaceae), *Ludwigia palustris* (L.) Elliott (water purslane or water primrose: Onagraceae), and *Polygonum arenastrum* Boreau (knotweed: Polygonaceae) (Delnavaz and Azimi 2009; Kannaiyan and Kumar 2006; Mozafarian 2007). *Azolla* is not native to the northern region of Iran and was introduced in 1986 (Delnavaz and Azimi 2009). However, many of the above-mentioned aquatic plants are native in this region (Mozafarian 2007) and many insects use them as food plants.

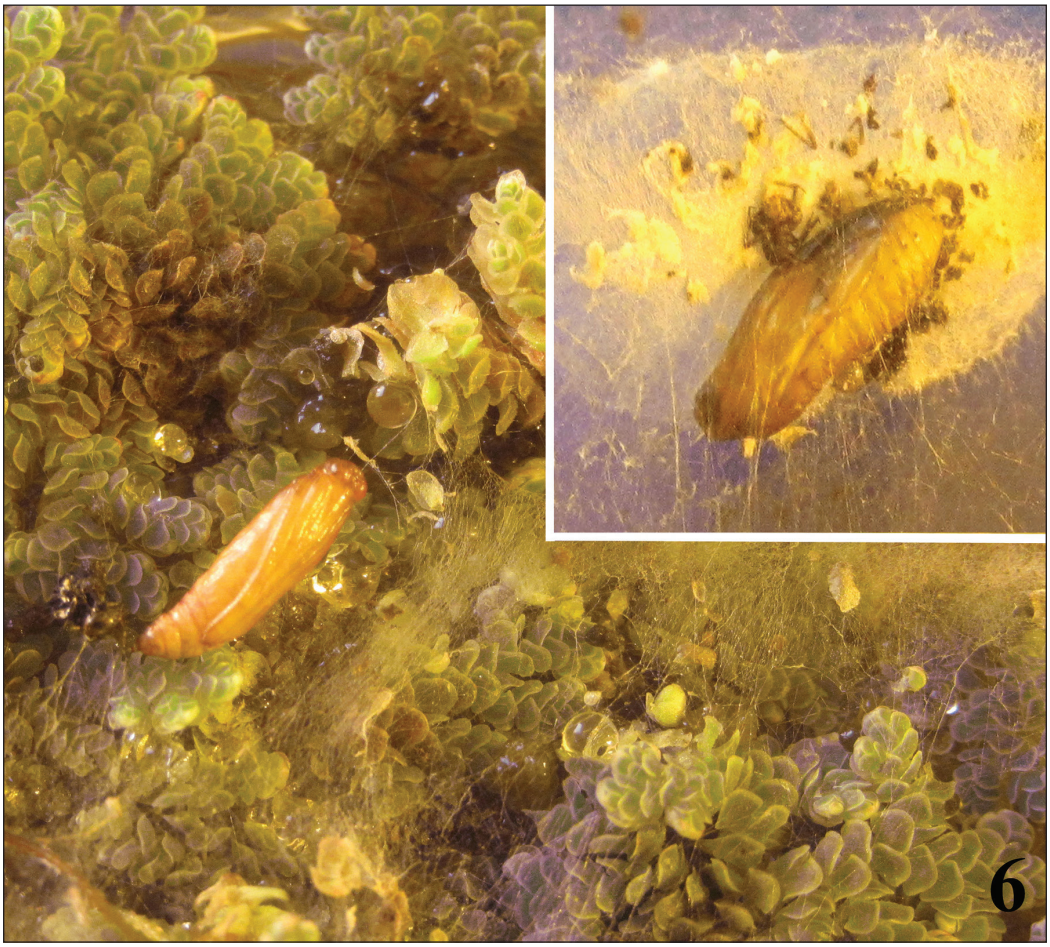
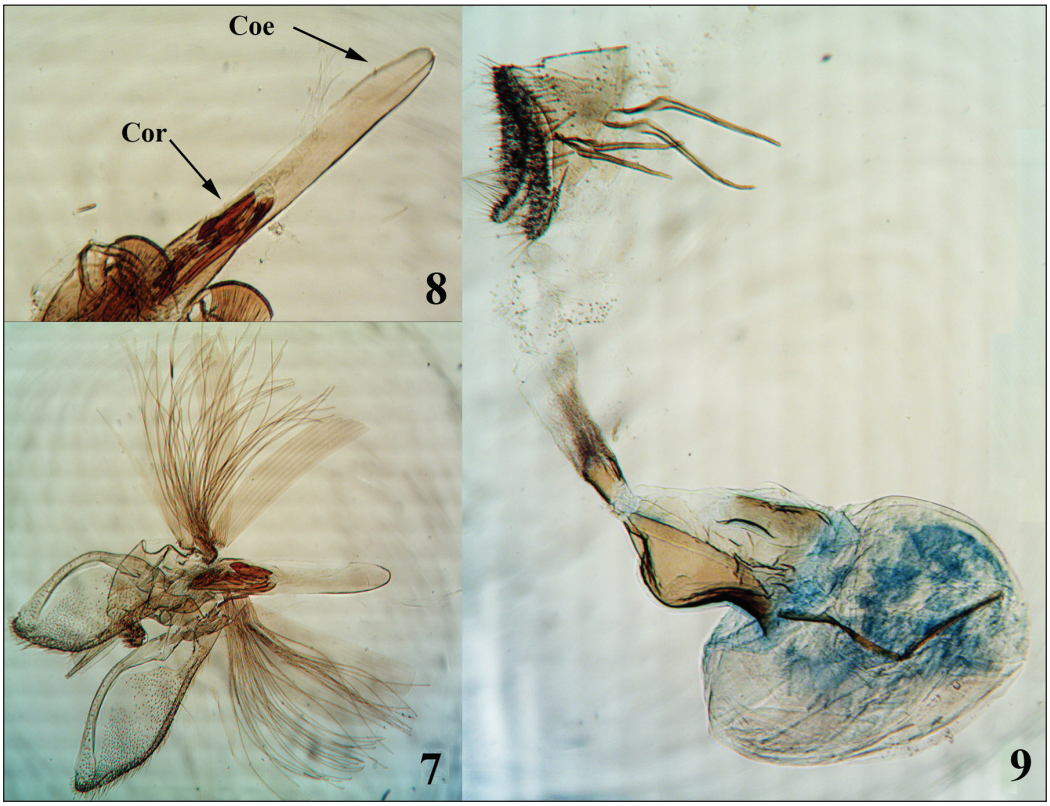


Figure 6. *Diasemiopsis ramburialis* pupa (Magnified: Mature pupa).

During the present study we investigated the activity of *D. ramburialis* on *Azolla* in rice fields. In Iran, *D. ramburialis* adults start their activity in July but they are most active in rice fields from September to late October. In these areas, this is almost the end of harvesting time and the end of the summer. The temperature gets slightly cooler and fields become half-dried, which eases harvesting. The reasons for the increase in the activity of adults in rice fields at the end of the summer, when water fern is getting dry due to water stress, are not clear.

Water depth could be a restricting factor for the activity of *D. ramburialis*. It is possible that pupae are sensitive to high water depth and are not able to survive under submerged conditions in rice fields during the cultivation season. In addition, culturing operations in rice fields disturb the water fern layer constantly and destroy pupae. However, after harvesting, since water fern remains undisturbed and fields become dry, *D. ramburialis* can increase its populations.

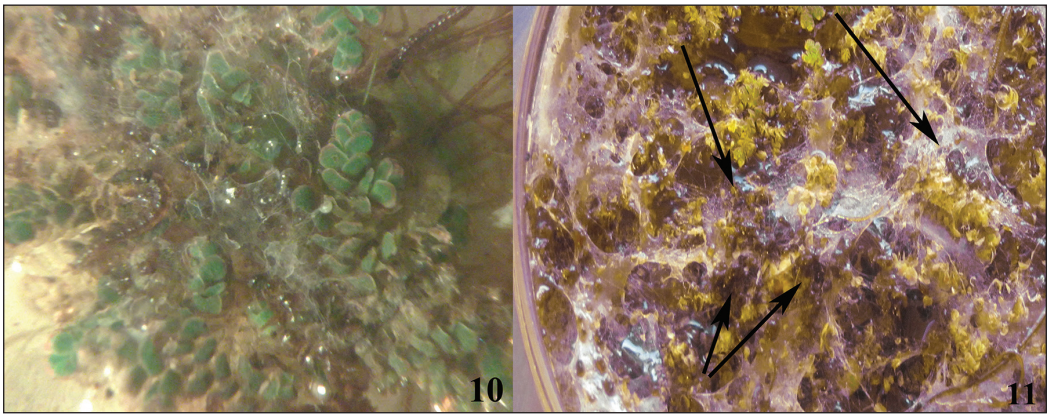
On the other hand, rice fields are an anthropogenic agricultural ecosystem in which thermal conditions can differ significantly from those of natural aquatic habitats. Discharge of heated water, artificial mixing of thermal strata, impoundment, diversion, regulation of water level



Figures 7–9. *Diasemiopsis ramburialis* genitalia. **7.** Male genitalia with phallus to the right and uncus+tegumen underneath right (top) valva. **8.** Phallus (Cor = Cornuti; Coe = Coecum). **9.** Female genitalia.

and flow, and canopy opening in riparian zones, through harvest or grazing, severely modify the thermal environment for aquatic species (Ward and Stanford 1982). Therefore, in wetlands without the disturbance of agricultural processes and chemical compounds *D. ramburialis* could behave differently.

Our study is the first to record a host plant for *D. ramburialis* and the genus *Diasemiopsis* because the host plant of the North American *D. leodocusalis* is still unknown. However, there are other Spilomelinae, such as the salvinia stem borer *Samea multiplicalis* (Guenée), that feed on several Salviniaceae and *Azolla*. This moth has been known as a potential biocontrol agent for *Salvinia molesta* DS Mitchell (Pelli et al. 2008). In host range tests Knopf and Habeck (1976) stated that this moth has three main host plants in Florida (USA): *Azolla caroliniana*, *Pistia stratiotes*, and *Salvinia rotundifolia*. However, this moth has not been reported on these host plants from Iran or the Palaearctic and African regions. Although we briefly studied the biology of *D. ramburialis* as a probable biotic resistance factor for water fern, many other important biological aspects such as life span in natural habitats, population growth parameters, host range, and host preference remain unclear. Also, we could not find any specific parasitoid or predator for this moth although there are many generalist predators and parasitoids active in rice fields (Ooi and Shepard 1994; Shepard et al. 1987) that could affect *D. ramburialis*.



Figures 10–11. Feeding activity and webbed shelters of *D. ramburialis* larvae. **10.** First instar larva making feeding shelter with silk. **11.** Shelter full of frass after larval feeding.

Conclusion

Environmental conditions of northern regions of Iran, in addition to agricultural activity, put native living organisms under various kinds of stress and shape them into trying to adapt to different conditions. However, in comparison to the long period of adaptation of native species, some exotic organisms such as water fern have adapted themselves to local conditions in a shorter period of time and have become dominant in some areas (Delnavaz and Azimi 2009; Sadeghi et al. 2013). This invasion puts native plants under pressure and the insects that feed on native plants either have to use new plants as a food resource or die of hunger. Despite a rich fauna of aquatic and semi-aquatic insects, water fern biotic resistance factors in Iran are still poorly known. We started our surveys on water fern biotic resistance factors in Iran's northern region rice fields in 2013 and this is the first report of our results. More studies are under way to uncover important facts on the biotic resistance factors of this non-native invasive weed in northern regions of Iran.

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Taxonomy of two montane *Dichrorampha* species from the Balkans and Caucasus (Lepidoptera, Tortricidae)

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Abstract. *Dichrorampha pentheriana* (Rebel, 1917), previously known only from the type locality in Montenegro, is reported from the Vitosha Mountains in Bulgaria, at an altitude of 2100 m. Data on the habitat and the suspected larval host plant (*Achillea lingulata* Waldst. & Kit., Asteraceae) are provided. A new species, *Dichrorampha sakartvelana* sp. n., is described from the Georgian Great Caucasus Mountains, at altitude 2280 m. Male and female moths and their genitalia are illustrated with photographs and line drawings.

Introduction

The genus *Dichrorampha* Guenée, 1845 comprises 142 species as listed in the Online World Catalogue of the Tortricidae (Gilligan et al. 2014). Most known representatives occur in the Holarctic region, but this tendency may change; a plethora of new species from the Neotropics have been described during last few years (e.g., Razowski 2011, Razowski and Becker 2012). The complicated taxonomy of the genus is reflected in the extended synonymy (a total of 89 synonyms is listed in the Catalogue). Many *Dichrorampha* species have a limited distribution and may be restricted to particular mountain ranges, i.e. endemism is a common phenomenon within the genus, and one can expect larger numbers of undescribed relict and endemic taxa in high mountain massifs. In this context discovery of a new species from the vast Great Caucasus Mountains range was not surprising. More than 30 species are known from Caucasus (Danilevsky and Kuznetzov 1968, Esartiya 1988), 13 of them are endemics for this region. More unexpected was the discovery of *Dichrorampha pentheriana* (Rebel, 1917) in the vicinity of Sofia, in the small but relatively high (2290 m) Vitosha Mountains. Twenty-three *Dichrorampha* spp. are reported for Bulgaria, one of them (*D. rilana* Drenowsky, 1909) endemic for the highest Bulgarian mountains (including Vitosha).

The larvae of most *Dichrorampha* spp. feed on different Asteraceae, mainly two genera: *Achillea* and *Tanacetum* (Danilevsky and Kuznetzov 1968). They are internal feeders in root tissues.

Two nicely patterned female *Dichrorampha* were swept from *Achillea lingulata* Waldst. & Kit. (Asteraceae) in the summer of 2012 in Vitosha Mountains, Bulgaria. Dissection of the genitalia of the female did not provide a reliable identification; additional male specimens were needed but at the time of dissection the season was already over. Collecting of males was postponed to the year 2014, which unfortunately had a very cold and rainy summer; only a single worn female came from the three excursions. Eventually, in June 2015, two males as well as two females were swept from a mountain meadow with numerous flowering *A. lingulata*. The unmistakable genitalia of the

dissected male clearly demonstrated that this odd looking *Dichrorampha* is *D. pentheriana* (Rebel, 1917), until now known only from the type series.

An unknown *Dichrorampha* was discovered in 2014 during an entomological expedition in the Great Caucasus Mountains, Georgia. The two moths were captured in late afternoon flying around tufts of *Achillea* sp. growing on the rocks alongside a mountain road. Subsequent sweeping of the same (and other) *Achillea* species did not provide more material, and an approaching thunderstorm suspended any further efforts to collect additional specimens; the locality was not visited again. The specimens collected have identical wing patterns and are of similar size, which in combination with their synchrony and syntopy suggest that they are conspecific. The habitus, wing pattern and genital characters of both male and female moths show unquestionable affiliation to the genus *Dichrorampha*, but do not match any known species in this genus.

The purpose of the paper is to illustrate and provide additional data and a redescription for the little known *Dichrorampha pentheriana* and to describe *D. sakartvelana* sp. n.

Abbreviations of collections

BFUS	Zoological collection of Sofia University St. Kliment Ohridski, Faculty of Biology, Bulgaria
NHMW	Naturhistorisches Museum Wien, Austria
NMNHS	National Museum of Natural History Sofia, Bulgaria

Methods

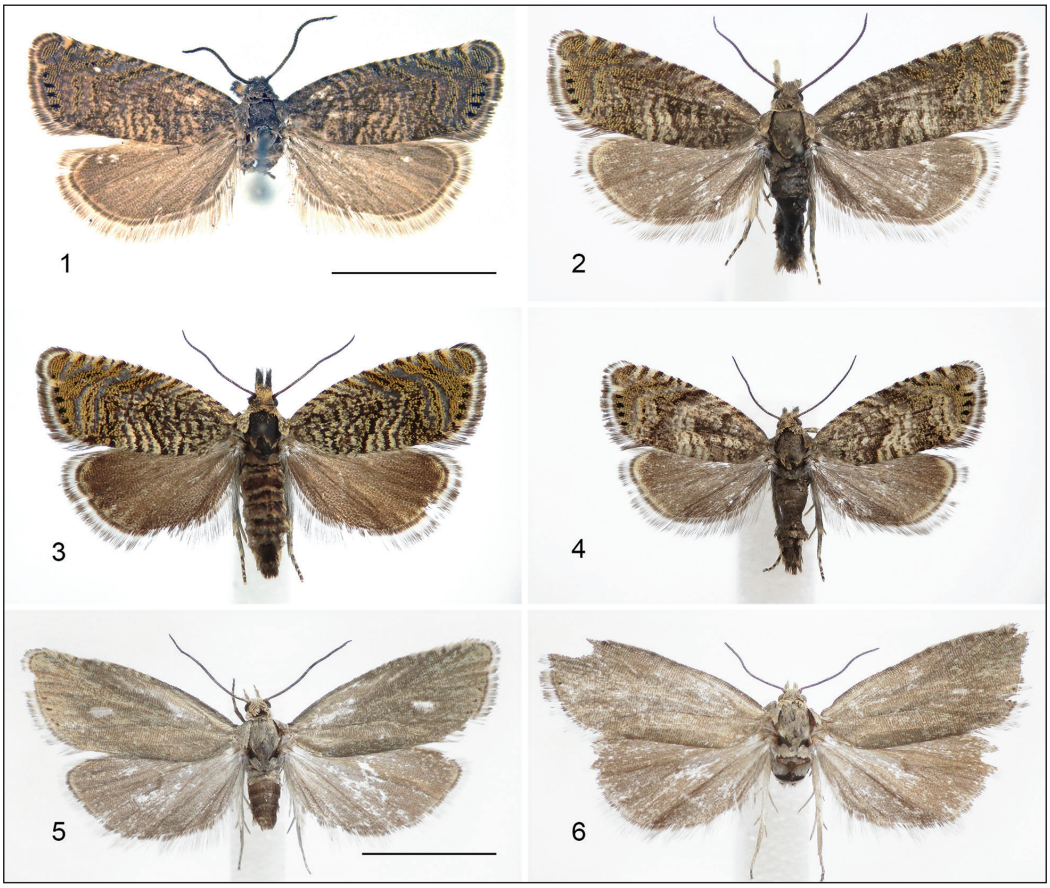
The moths were captured with aerial insect nets, killed with ethyl acetate and spread immediately. Later the abdomens were dissected and the genitalia were processed following the procedure of Robinson (1976). The type series of *D. pentheriana* was used for comparison with the Bulgarian specimens. The male paratype of *D. sakartvelana* was compared with male specimens of *D. petiverella* (Linnaeus, 1758) and *D. filipjevi* (Danilevsky, 1948). The nomenclature of the wing pattern follows mainly Baixeras (2002). The holotype of *D. sakartvelana* sp. n. will be deposited in BFUS, and the paratype in NMNHS. The *D. pentheriana* specimens are preserved in BFUS.

Dichrorampha pentheriana (Rebel, 1917)

Figs 1–4, 7–10, 14

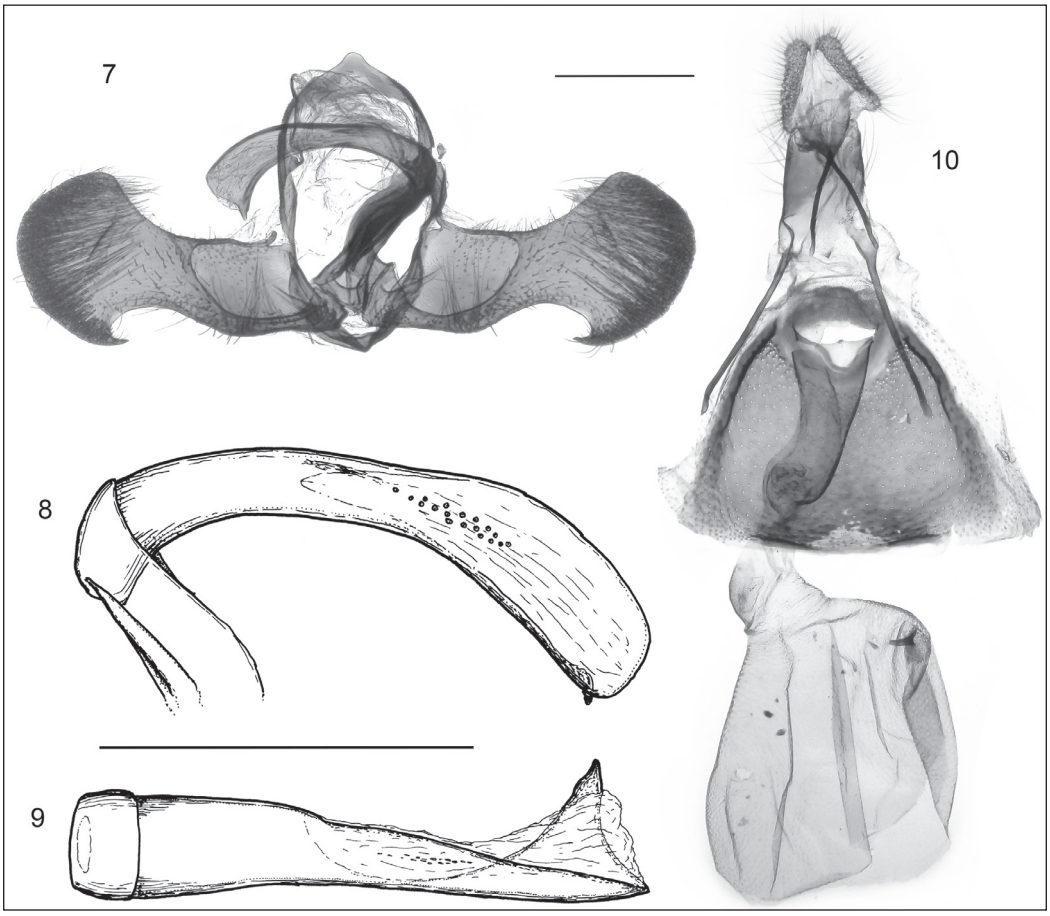
Material. 2 ♂, Bulgaria, Vitosha Mts, near Cherni vrah chalet, 2100 m a.s.l., N 42°34’20” E 23°17’03”, 11.vii.2015, leg. B. Zlatkov & E. Tasheva, coll. BFUS; 2 ♀, ibid.; 2 ♀, ibid. but 13.vii.2012, leg. B. Zlatkov & D. Gradinarov; 1 ♀, ibid. but 25.vii.2013, leg. B. Zlatkov.

Redescription based on the Bulgarian specimens (Figs 2–4). Sexual dimorphism subtle. Head: Frons and vertex pale brown, palpus labialis yellow encircled with black scales. Antennae with beige scales. Thorax: Upperside, including patagia and tegulae, grey-brown, in some specimens scales with beige tips. Underside anterior pale grey, posterior and legs dark grey. Forewing length male 6.7–6.8 mm, female 5.7–6.5 mm, wingspan in set specimens 12.0–14.5 mm. Forewings moderately wide, without costal fold in males, with slightly convex costal edge (more convex in females than in males). Upperside wing pattern contrast, especially in females (Figs 3, 4),



Figures 1–6. *Dichrorampha* spp. **1–4**, *D. pentheriana* (Rebel, 1917): **1.** lectotype ♂, Montenegro, Zljeb Mts, 23.vi.1916, coll. NHMW (courtesy of NHMW); **2.** ♂, Bulgaria, Vitosha Mts, 11.vii.2015, coll. BZ; **3.** ♀, the same data but 13.vii.2012; **4.** ♀, the same data but 11.vii.2015; **5–6**, *D. sakartvelana* sp. n.: **5.** paratype ♂, Georgia, Great Caucasus Mts, 27.vii.2014, coll. NMNHS; **6.** holotype ♀, ibid. Figures **1–4** and **5–6** are proportional. Scale bar: 5 mm.

consisting of numerous pale and dark transverse lines. Nine pairs of creamy distinct costal strigulae. Lead refractive transversal lines (striae) emerge from pairs 3–7; line of pair 3 ill-defined and pronounced only in some specimens; line of pair 4 reaching the discal cell; lines of pairs 5 and 6 initially merged then divided forming the refractive lines of the speculum; line of pair 7 short, dot-like; lines of pairs 8 and 9 relatively short, convergent and connected with creamy terminal ("postapical") strigulae. All pattern elements from the wing base to the median fascia consist of black and beige ill-defined lines, forming a vestigial dorsal patch in the region of the interfascial area basad to the median fascia. Median fascia darker, with black and golden-tipped scales; these scales predominate in the distal wing pattern. Four black terminal dots are present in most specimens; in some an additional dot above the terminal strigula is present. Forewing underside beige-grey, with distinct costal and terminal strigulae and terminal dots corresponding to the same upperside elements. Cilia grey-brown with pale median line. Hindwings upperside monochrome



Figures 7–10. Genitalia of *Dichrorampha pentheriana* (Rebel, 1917). **7.** Male genitalia photographed under coverslip, specimen Vitosha Mts, 11.vii.2015; **8–9**, phallus drawn without coverslip in left (**8**) and dorsal (**9**) view. **10.** Female genitalia, specimen Vitosha Mts, 13.vii.2012. Figures 7 and 10 are to the same scale. Scale bar: 0.5 mm.

grey-brown with beige terminal line. Underside pale grey with paler terminal line. Cilia paler than those of the forewing. Abdomen dark grey.

Male genitalia (Figs 7–9): In agreement with the preparation of the genitalia of the lectotype as well as the description by Razowski (1971). The shape of valva and phallus depends on the pressure of the coverslip. For example, the cavity at the proximal part of cucullus looks deeper or shallower depending on the pressure applied. The same is valid for the phallus: the large triangular terminal process in natural condition is pointed laterally at right (Figs 8, 9), but under a coverslip it is ventrally oriented (Fig. 7).

Female genitalia (Fig. 10): In agreement with the preparation of the genitalia of the female paralectotype and the description by Razowski (1971).

Diagnosis. The wing pattern of *D. pentheriana* resembles that of *D. distinctana* (Herrich-Schäffer, 1851) but is easily distinguished by lacking the costal fold. The male genitalia are

distinctive and do not show obvious affinities to other species of the genus. The shape of the valva is relatively similar to those of some forms of *D. plumbana* (Scopoli, 1763), but the phallus is strikingly different. The female genitalia are less characteristic, with antrum (sclerotised posterior part of ductus bursae) similar to some extent to those of *D. bugnionana* (Duponchel, 1843).

Biology. The species is on the wing from mid June to late July. The larval host plant in all likelihood is *Achillea lingulata* Waldst. & Kit., considering the fact that many *Dichrorampha* feed on *Achillea* and all specimens were swept during the florescence period of *A. lingulata* from its stems or surrounding grass vegetation. Other *Achillea* spp. and also other Asteraceae growing in the vicinity were searched for *D. pentheriana* without a positive result, so *D. pentheriana* is likely to be monophagous. The habitat is a subalpine meadow at an altitude of ca. 2000 m (Fig. 14).

Distribution. Zljeb Massif (part of Prokletije Mts, between Montenegro and Serbia) and Vitosha Mts (Bulgaria).

Remarks. Rebel (1917) described *D. pentheriana* from three specimens (2 males, 1 female) collected in Zljeb Mountains, Montenegro, at an elevation of 1700 m, preserved in NHMW. Obraztsov (1953) did not examine the type series and erroneously claimed that it consists of only two males. Danilevsky and Kuznetzov (1968) also did not examine the specimens and similarly gave wrong information about the specimens of the type series: three males and one female. Razowski (1971) dissected a male and female syntype, designated the male as lectotype, and provided descriptions and illustrations of male and female genitalia for the first time. The subtle differences in the genitalia of the Bulgarian specimens compared to those of the type series are likely due to normal variation and/or deformation by pressure of the coverslip.

No colour illustrations of the adult can be found in literature with the exception of those in Razowski (2003) (paralectotype male; the photograph is apparently altered digitally and shows some differences with the original appearance of the specimen). The lectotype (Fig. 1) is illustrated here for comparison with some of the Bulgarian specimens. As seen in the figure, the moths from Vitosha demonstrate two differences with the types: a more contrasting forewing pattern, especially in females and the presence of pale terminal line on the hindwings.

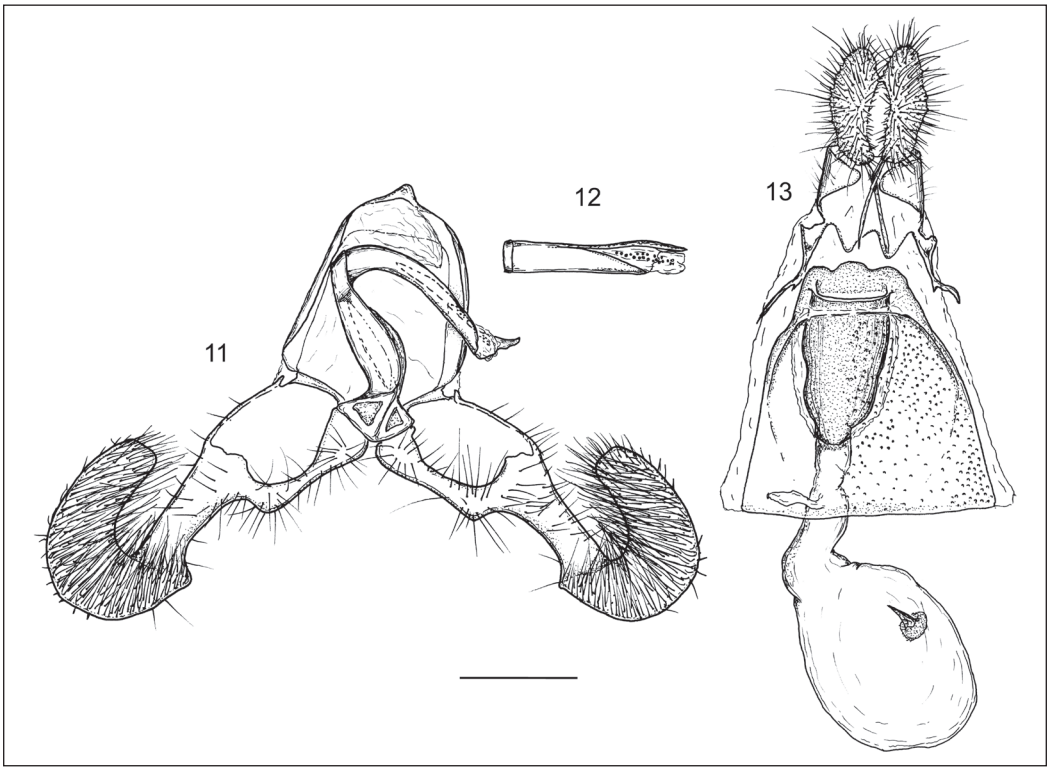
Dichrorampha sakartvelana sp. n.

http://zoobank.org/1919B149-1E92-49DA-90BB-4E1689F9C42D

Figs 5–6, 11–13, 15

Material. Holotype ♀, with three labels: "Georgia, Great Caucasus | Mountains, Caucasus Range, | near Abano pass | 2280 m N 42°15'54" E 45°30'17" | 27.vii.2014, netting | leg. B. Zlatkov", "Holotypus ♀ | *Dichrorampha* | *sakartvelana* | det. B. Zlatkov 2015 [red label]", "BFUS | ♀ | Genitalia slide | No. 27.vii.2014/1", BFUS. – Paratype ♂, with three labels: the first as in Holotype; the other two: "Paratypus ♂ | *Dichrorampha* | *sakartvelana* | det. B. Zlatkov 2015 [red label]", "NMNHS | ♂ | Genitalia slide | No. 27.vii.2014/2", NMNHS.

Description. Adult (Figs 5–6). Sexual dimorphism subtle. Head: Frons and vertex covered with brown-grey scales. Palpus labialis with whitish basal and brown-grey distal segment; the second segment with whitish base and brown tuft at the distal end. Antennae covered with dark grey scales. Thorax: Nota, patagia and tegulae uniformly grey, thorax underside (including coxae) whitish, legs brown. Forewings comparatively wide, in male with costal fold with 1/5 of the length of the costal edge. Forewing length male 8.65, female 8.90 mm, wingspan in set specimens



Figures 11–13. Genitalia of *Dichrorampha sakartvelana* sp. n. **11.** Male genitalia, paratype; **12.** Phallus, dorsal view, paratype; **13.** Female genitalia, holotype. Scale bar: 0.5 mm.

18.5–19 mm. The specimens are worn, but preserved areas on the forewing upperside have pale greenish-grey overlaying scales which apparently do not form an obvious pattern. No markings are visible with the exception of five pairs of faint distal costal strigulae (pairs 5–9 sensu Baixeras, 2002). Three black terminal dots are present. Underside uniformly brown. Cilia creamy with pale brown margin. Hindwings with pale brown upperside and whitish underside. Cilia whitish. Abdomen covered with pale grey scales.

Male genitalia (Figs 11–12): Tegumen bearing a small lobe as uncus. Valva broad basally with wide basal cavity. Costal edge slightly convex. Sacculus nearly parallel to costal edge, indistinctly concave, ending with nearly straight angle. Ventral incision elongated, trapezoidal. Neck of valva slender, more than two times narrower than the basal part of valva and relatively long, 3/4 of its length. Cucullus with large dorsal lobe, densely covered with long setae, and a small rectangular ventral prominence. Phallus slender, ca. 3/5 of the length of valva, bent ventrally in the basal part, with membranous area extending at first on right, then on dorsal side. A large triangular prominence pointed dorsally at the right side of the tip is present. Circa 20 sockets of deciduous cornuti are counted.

Figures 14–15. Habitats. **14.** Habitat of *Dichrorampha pentheriana* (Rebel, 1917), Vitosha Mts, 13.vii.2012, foreground: the suspected larval host plant *Achillea lingulata* (photo: D. Gradinarov); **15.** Habitat of *D. sakartvelana* sp. n., Great Caucasus Mts, Tusheti Range, 27.vii.2014 (photo: M. Ilieva).

Female genitalia (Fig. 13): Papillae anales wide. Apophyses posteriores equal in length to the apophyses anteriores, the latter look naturally deformed. Sterigma sclerotised, slightly asymmetrical, trapezoidal, with two incisions on the posterior margin of the postostial part. Ostium wide. Subgenital plate trapezoidal with distinctly sclerotised lateroposterior margins and rounded posterior angles. Antrum with the length of the membranous part of ductus bursae, well sclerotised, remarkably wide, nearly symmetrical, wineglass shaped and enveloped in a thin cuticular membrane visible after staining. The proximal sclerotisation of ductus bursae is barely discernible only under higher magnification. Ductus seminalis emerging at the middle of the membranous ductus bursae. Corpus bursae ovoid. A single moderately sized signum is present.

Diagnosis. The new species is characterized externally by uniformly coloured forewings (though the specimens are not fresh) and large size. The male genitalia resemble some species of the "section petiverellae" (sensu Danilevsky and Kuznetzov 1968), which apparently are closely related to *D. sakartvelana* sp. n. *D. flavidorsana* Knaggs, 1867 and *D. filipjevi* (Danilevsky, 1948) have similarly shaped valva, but the apical prominence of the phallus is pointed ventrally, and the ventral process of the cucullus is much larger in *D. filipjevi*. *D. petiverella* (Linnaeus, 1758) and *D. proxima* (Danilevsky, 1948) are also similar in general, but they have two distinct processes of the cucullus. Female genitalia do not demonstrate clear affinities to any Palaearctic *Dichrorampha*.

Preimaginal stages. Unknown.

Biology. The moths were collected at the end of July, but their condition presumes that they are on the wing earlier. The larval host plant is most probably *Achillea* sp. above which the moths were flying (plant material was not preserved and an exact identification is thus not possible). The habitat (Fig. 15) is a subalpine meadow at an elevation of ca. 2300 m with denuded rocks where the host plant grows.

Distribution. Known from the type locality only.

Etymology. The name of the species is an adjective, derived from the autonym for Georgia, *Sakartvelo*, and the specific ending for Tortricidae -*ana*.

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New data on the distribution of Cossidae (Lepidoptera) in Mongolia

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Abstract. We recorded a new species of Cossidae – *Acossus terebrus* (Denis & Schiffermüller, 1776) – for Mongolia (Tov Aimak). We also report on the most northern habitat of the cossid genus *Gobibatyr* Yakovlev, 2004 (North-West Mongolia, Bayan-Ulegej Aimak), which shows the permeability of the Mongolian Altai Mountain Range for some elements of the Dzungarian fauna. Additionally, our sampling resulted in adding new localities to the ranges of *Catopta perunovi* Yakovlev, 2007 and *Cecryphallus nubila* (Staudinger, 1895) (first discovered in Hovd Aimak).

Introduction

The Carpenter-Moths (Lepidoptera, Cossidae) in Mongolia are relatively well known compared to their fauna in most other countries. Several articles (Daniel 1965, 1969, 1970, 1973; Yakovlev 2004, 2015a) treating the systematics and distribution of Mongolian Cossidae were published. It was established that the Cossidae fauna of Mongolia is distinct (Yakovlev and Dubatolov 2013; Yakovlev 2015b). In total, 23 species were reliably recorded; in addition, two species, *Acossus viktor* (Yakovlev, 2004) and *Cossus shmakovi* Yakovlev, 2004, were recorded from the border regions of Russia (the Republic of Tuva, the Tes-Khem River valley), so they are likely present in Mongolia as well.

It is worth noting that the Cossidae fauna of Mongolia is highly distinct based on the presence of 13 endemic species (*Catopta saldaitisi* Yakovlev, 2007, *Gobibatyr ustyuzhanini* Yakovlev, 2004, *Chingizid gobiana* (Daniel, 1970), *Ch. transaltaica* (Daniel, 1970), *Ch. kosachevi* Yakovlev, 2012, *Cossus kerzhneri* Yakovlev, 2011, *Deserticossus beketi* (Yakovlev, 2004), *D. churkini* Yakovlev, 2006, *D. mongoliana* (Daniel, 1969), *Eogystia kaszabi* (Daniel, 1965), *Kerzhnerocossus sambainu* Yakovlev, 2011, *Dyspessa saldaitisi* Yakovlev, 2011 and *Phragmataecia anikini* Yakovlev, 2011) and two endemic genera (*Kerzhnerocossus* Yakovlev, 2011 and *Chingizid* Yakovlev, 2011). All Mongolian endemics, except for *Catopta saldaitisi*, inhabit deserts and semideserts. The field study of the first author in 2015, data from other researchers and the material studied in the Hungarian Museum of Natural History (Budapest) enabled us to uncover new localities for a series of rare species and also to discover a species new for the Mongolian fauna.

Material and methods

The adult Cossidae were collected using the combined light lamp Phillips−250 W mounted above a fabric screen, battery light traps with the lamp Philips TL 8W/05 and chloroform as the killing agent.

Results

New species for Mongolian fauna

Acossus terebrus (Denis & Schiffermüller, 1776) (Figs 1A, 2) – widely distributed transpalaearctic species (Daniel 1956; Yakovlev 2007, 2011a), rather rare in most of the localities, for the first time reliably recorded in the Mongolian fauna. This discovery was expected as *A. terebrus* is reliably known from the neighboring regions of Russia (the Republic of Altai, Tuva, Buryatia, Irkutsk and Chita regions) and China (Inner Mongolia Province) (Hua et al. 1990).

Material examined: 1 ♂, Mongolia, Töv aimag, 11 km S Jargalant, 48°24.875'N; 105°50.713'E, 1320 m, 7.vii.2008, leg. Balász Benedek (Hungarian Museum of Natural History, Budapest).

New records

***Gobibatyr ustyuzhanini* Yakovlev, 2004** (Figs 1B, 2)

The genus *Gobibatyr* Yakovlev, 2004 was established for *Cossus colossus* Staudinger, 1887. *Gobibatyr colossus* (Staudinger, 1887) was reported from several localities in the Ili River valley in southeast Kazakhstan, Kyrgyzstan (the Naryn River valley) and extreme southwest of Mongolia (the Bayan-Gol River valley (right tributary of Bulgan-Gol River) in Hovd Aimak) (Yakovlev 2004, 2015a). The second species of this genus is *G. ustyuzhanini* Yakovlev, 2004, described from southwestern Mongolia (type locality − S Mongolia, Gobi-Altai Aimak, 30 km S Biger) (Yakovlev 2004). Later the distribution of *G. ustyuzhanini* in Mongolia was specified (Yakovlev 2015a). In addition to the discoveries in Mongolia, this species (given as *Cossus colossus*) was indicated (without specification of exact localities) for Qinghai, Gansu, and Ningxia Chinese Provinces (Hua et al. 1990). It was found that the larvae of *G. ustyuzhanini* Yakovlev, 2004 feed on the underground parts of *Nitraria schoberi* L. (Zygophyllaceae) (Yakovlev 2011b). The same paper gives the description of the eggs and pupae (based on exuvia). During the Russian expedition to Mongolia, M. Bush (Moscow) collected a series (3 males, 1 female) of *G. ustyuzhanini* in the northeast of Bayan-Ulegej Aimak in Mongolia on the southern bank of Achit-Nuur Lake. The exact data on the label are the following: Mongolia, Bayan-Ulegej Aimak, 65 km NW of Ulegej, S bank of Achit-Nuur lake, 49°25'52.16''N; 90°30'19.01''E, 1440 m, Bush M. legit. (coll. R.V. Yakovlev, Barnaul, Russia).

Remarks. The Mongolian Altai is a significant frontier in the distribution of insects. This conclusion is based on the distribution of Orthoptera (Sergeev 1986), Coleoptera (Kryzhanovskij 2002), Papilionoidea (Yakovlev 2011), and Cossidae (Yakovlev 2015b). The discovery of *G. ustyuzhanini* significantly extends the range of the genus *Gobibatyr*. All the previously known discoveries of *G. ustyuzhanini* were located on the south (Dzhungarian) macroslope of the Mongolian Altai, in Dzungarian and Zaaltayskaya Gobi on the territory of Hovd, Gobi-Altai and South Gobi Aimaks of Mongolia (Hovd Aimak, Janatin Dolon, 40 km N Somon Manchan, SW bank of Khar-Us nuur Lake; Hovd Aimak, Bodonchijn-Gol basin, Hundijn-Gol River valley; Hovd Aimak, 10

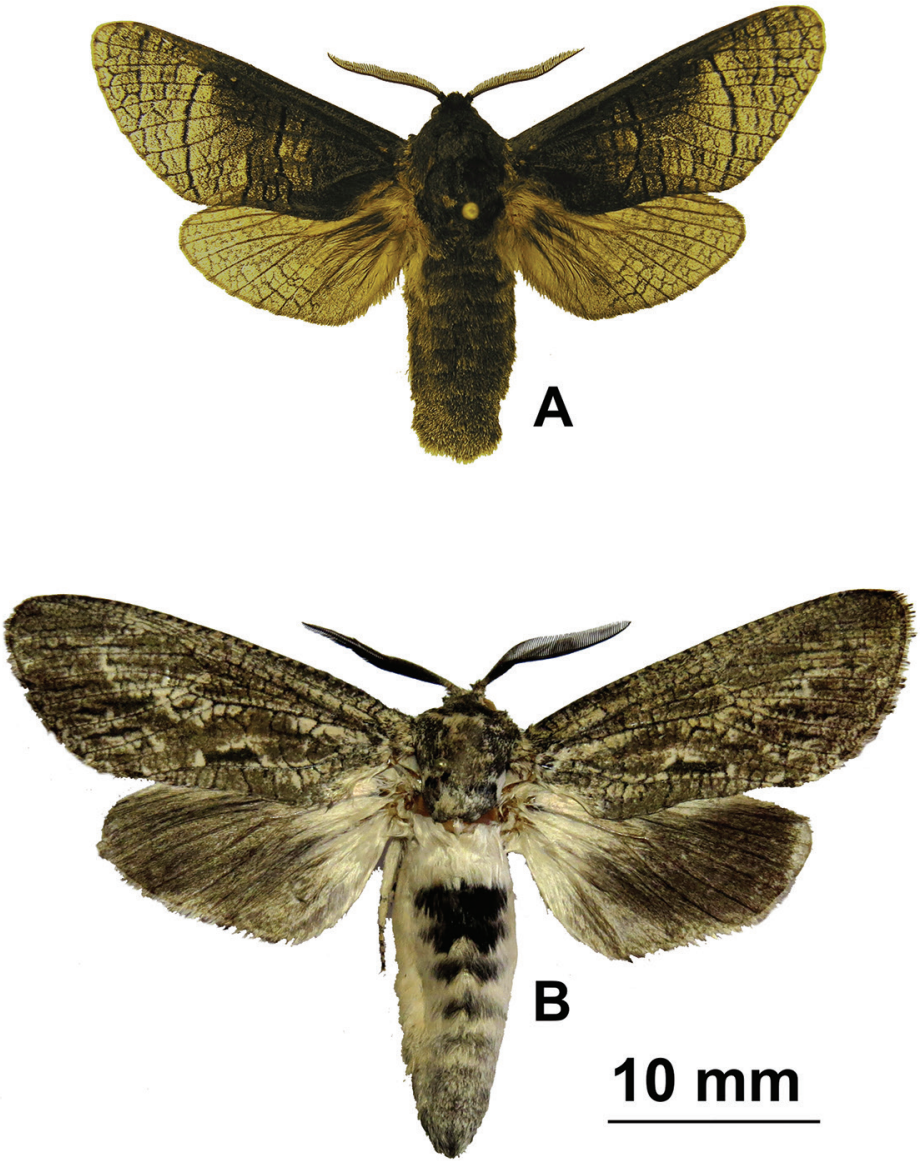

Figure 1. (**A**) *Acossus terebra* (Denis & Schiffermüller, 1776), Mongolia (Hungarian Museum of Natural History, Budapest) and (**B**) *Gobibatyr ustyuzhanini* Yakovlev, 2004, male (coll. R.V. Yakovlev, Barnaul, Russia) (Lepidoptera, Cossidae).

km SSW Somon Bulgan; Gobi-Altai Aimak, between Beger nuur and somon Beger; Gobi Altai Aimak, Baga nuur urd els, SE bank of Doroo nuur Lake; Gobi-Altai Aimak, Zachuj Gobi, 10 km N of Chatan chajrchan Mountain; Gobi-Altai Aimak, Mongolian Altai Mountains, S slope, Mogoijn-Gol Valley; Gobi-Altai Aimak, 30 km N of Biger; Southern Gobi Aimak, 70 km SW of Khan-Bogdo Somon; Southern Gobi Aimak, 50 km SSE of Noen; Southern Gobi Aimak, Bulgan

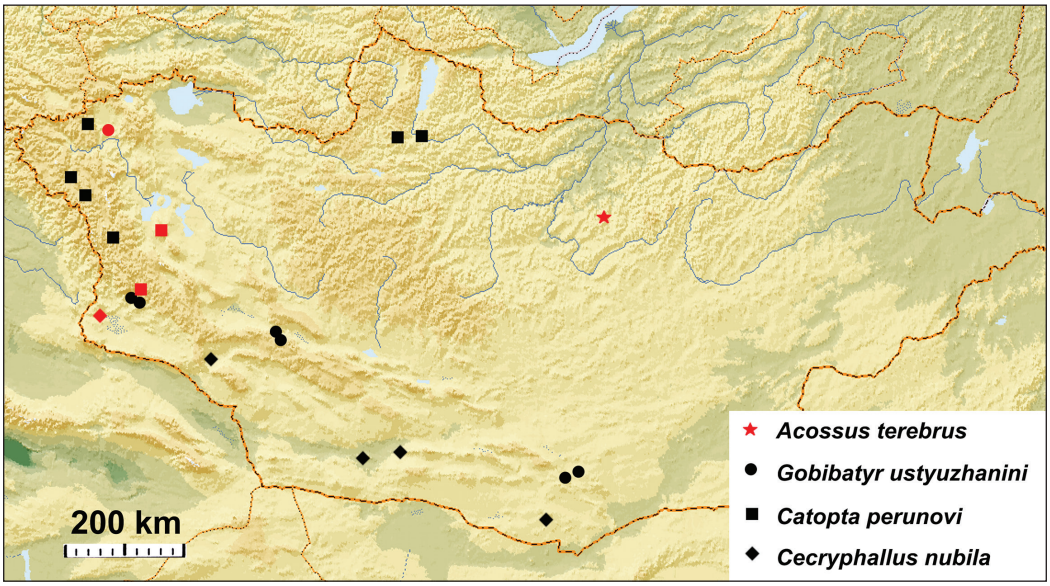

Figure 2. Distribution map of *Catopta perunovi* Yakovlev, 2007, *Gobibatyr ustyuzhanini* Yakovlev, 2004, *Acossus terebra* (Denis & Schiffermüller, 1776) and *Cecryphallus nubila* (Staudinger, 1895) in Mongolia (Lepidoptera, Cossidae). Red = new locality.

Somon, Talyn Bulay) (Yakovlev 2015a). It was previously believed that the Mongolian Altai is a barrier to the dispersal of *G. ustyuzhanini* to the north, preventing its penetration to the Great Lakes Valley (Yakovlev and Dubatolov 2013; Yakovlev 2015b).

Catopta perunovi Yakovlev, 2007 (Fig. 2)

The species was described from the material from Russia, Altai Rep., Ongudai. It was recorded in several localities of northwestern Mongolia on the territory of Chovsgol and Bayan-Ulegei Aimaks (Yakovlev 2015a), first reliably recorded in Hovd Aimak.

Material examined: 8 ♂, W Mongolia, Hovd Aimak, Dzun-Dzhargalant-Khairkhan, Ar-Shatyn-Gol River Valley (47°44'N; 92°27'E), 2130 m, 26.vi.2015., leg. R. Yakovlev; 1 ♂, SW Mongolia, Hovd Aimak, Mongolian Altai (S slope) Bodonchin-Gol basin, Khondijn-Gol Valley, (46°08'N; 92°30'E), h = 1750 m, 27.vi.2015. leg. R. Yakovlev (coll. R.V. Yakovlev, Barnaul).

Cecryphallus nubila (Staudinger, 1895) (Fig. 2)

The species was described from Kaschgar [northwestern China, Tura], widespread in southern Kazakhstan, Kirgiziya, southern Mongolia (Gobi-Altai, Bayan-Khongor and South-Gobi Aimaks), Uzbekistan, Tadzhikistan, Azerbaijan, southern Armenia, Turkmenistan, northern Iran, and Xinjiang, China (Yakovlev 2015a). First discovered in Hovd Aimak.

Material examined: 1 ♂, SW Mongolia, Hovd Aimak, Dzhungarian Gobi Desert, S slope Barangijn-Nuruu Mts., 3 km S Barangijn-Tataal kuduk, (45°53'N; 91°19'E), 1300 m, 3.vii.2015, leg. R. Yakovlev (coll. R.V. Yakovlev, Barnaul).

Conclusion

At present 24 Cossidae species from 13 genera have been reliably recorded in Mongolia. The distribution of the genus *Gobibatyr* Yakovlev, 2004 has been significantly extended (the northern border of the habitat has been shifted by 450 kilometers). Despite numerous past efforts focused on the study of the Mongolian Cossidae, it appears that much can still be discovered, especially in the southeast of the country, from where little material is known.

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A synonymic list of names associated with western Palaearctic *Melitaea phoebe* (Denis & Schiffermüller, 1775) species group taxa (*M. phoebe*; *M. punica* Oberthür, 1876; *M. ornata* Christoph, 1893) (Lepidoptera, Nymphalidae)

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Abstract. Following indecision and confusion in the literature regarding nomenclature and distribution of *Melitaea phoebe* (Denis & Schiffermüller, 1775) and its closely associated congeners *M. punica* Oberthür, 1876, and *M. ornata* Christoph, 1893, a synonymic list of *phoebe* names, and of names both correctly and mistakenly associated with *phoebe* species-group taxa, is presented. Explanatory footnotes provide the basis of a stable source for future discussion of *M. phoebe* species-group populations throughout the species' ranges.

Introduction

According to a recent revision (van Oorschot and Coutsis 2014), the genus *Melitaea* Fabricius, 1807, comprises some 98 species of phenotypically similar, medium sized nymphaline butterflies that occur throughout most of the Palaearctic Region and beyond. Adults are invariably orange-brown on the upper surface, with a series of black lines and other markings; several *Melitaea* species are notoriously difficult to separate using wing morphology due to their similarity in appearance (Jugovic and Koren 2014).

In this paper, we consider the common and widespread butterflies *Melitaea phoebe* (Denis & Schiffermüller, 1775) and *M. ornata* Christoph, 1893; the latter was not fully recognised as a species distinct from *M. phoebe* until 2005 (see below). We also confirm, not for the first time, that *M. punica* Oberthür, 1876, historically considered a subspecies of *M. phoebe*, is restricted in distribution to Africa north of the Sahara; the specificity of *M. punica* was confirmed by Tóth and Varga (2011). Some fundamental confusion has encompassed the use of names relating to these three phenotypically similar *Melitaea* species in the western Palaearctic. We believe that confusion, for which the present authors must take some responsibility (with others!), arose as a direct result of the realisation that a second *phoebe*-like taxon occurred in Europe, before the extent of the range of *M. ornata* was fully understood. Before that was established, some other names were briefly used in the literature (e.g. *emipunica* [by Russell et al. 2005] and *ogygia* [by Varga et al. 2005]).

As recognised here, the western Palaearctic Region extends from the Iberian Peninsula and Africa north of the Sahara in the west to the Ural Mountains and Kazakhstan in the east (approxi-

mately 60º East), and from the North Cape of Norway in the north to the Middle East, including Iran and Iraq, in the south (approximately 30º North). We recognise that a number of names relate to *Melitaea* taxa east of the Urals, and where these apply or may apply to the taxa considered in this paper, they are also included.

Background

A detailed analysis of the Palaearctic forms and varieties associated with *Melitaea* Fabricius, 1807, was made by Higgins (1941, 1944 [errata], 1955 [additions]). He recognised *M. phoebe* as a distinct species (Higgins 1941: 325–343, plate 14, figs 1–12; plate 15, fig. 8) with three subspecies: nominotypical *phoebe* (throughout the region except the Iberian Peninsula and North Africa), *occitanica* Staudinger, 1871 (Iberian Peninsula) and *punica* (North Africa). Considering what was available to Higgins at that time, he provided what remains a generally accurate assessment of the division of *M. phoebe sensu lato*. Higgins provided (1941: 325–343) an annotated list of 74 named forms, mostly originating from the western Palaearctic, and many described individual variations, seasonal forms and aberrations. He later added (Higgins 1955: 118) five additional synonyms for *M. phoebe*.

So where did it all go so wrong? Modern confusion seems to stem from Hesselbarth et al. (1995: 1030), who mistakenly (see Appendix: Note 3), used the complex name: '*M.* (*phoebe*) *punica telona*' for those *phoebe*-like butterflies from Turkey which were not, in their opinion – and undoubtedly correctly – *M. phoebe sensu stricto*. Understandably, their work was used as an anchor for subsequent papers on the region; for example, Çalişkan and Bozaci (2015) described a male aberration of what they considered to be *M. phoebe* from the province of Adana, Turkey, placing the name *ornata* as a synonym of "*M. punica telona*". They referenced Hesselbarth et al. (1995), from where their use of the combination '*punica telona*' presumably originated. With several researchers working in different parts of Western Europe and the Russian Federation, it is perhaps understandable that this spurious use of the name *punica* became so widely used (see Appendix: Note 3).

M. ornata was first recognised as a species separate from *M. phoebe* simultaneously by Varga et al. (2005), from Hungarian specimens, under the specific name *M. ogygia* Fruhstorfer, 1908 [TL: Island of Poros, Peleponnese, Greece] and by Russell et al. (2005), from specimens reared from a female from Montagna Longa, Palermo district, Sicily, under the name *M. emipunica* Verity, 1919 [TL: Palermo district, Sicily, Italy]. The presently known eastern limit of the distribution of the invariably univoltine species *M. ornata* may coincide with the eastern limit of our interpretation of the western Palaearctic (see above), although a recent publication by Korb et al. (2015) recorded *M. ornata* from Middle Asia (Kyrghyz Mts., Transili Alatau Mts. and Kungey Ala-Too Mts.). Previously, Korb (2011: 178) reported this same material as *M. phoebe saturata* but following molecular analysis of the preserved specimens by Korb et al. (2015) their identity was reassessed as *M. ornata*. We note that larvae from this area are yet to be observed and believe further research is required to confirm their identity.

Placement of *M. ornata* and some associated Russian taxa as synonyms of *M. phoebe* by van Oorschot and Coutsis (2014: 60) compounded the confusion referred to above. In the expectation of resolving some long-standing matters of nomenclature and distribution, we present an alphabetical list of names associated with *Melitaea phoebe* species-group taxa and place each

as a synonym of *M. phoebe* [Notes 1 & 6], *M. ornata* [Notes 2 & 6], or *M. punica* [Notes 3 & 6]. These actions are explained and supported by detailed notes (see the Appendix). The present authors do not recognise any subspecific divisions of *M. ornata* or *M. punica*; however, *M. phoebe s.s.* occurs in two distinct subspecies based on larval colour and distribution: *M. phoebe phoebe* [Note 4] and *M. phoebe occitanica* [Note 5], with which some names will be synonymised.

Distribution of *Melitaea phoebe*, *M. punica*, and *M. ornata* within the western Palaearctic, as currently known and understood

Distribution of *M. phoebe phoebe* and *M. phoebe occitanica* in the western Palaearctic is presented in Note 1. However, it is considered important to clarify some details as to where, so far as is currently known, *M. phoebe* has been recorded as being present in the literature but is not in fact present:

(1) *M. phoebe* has been recorded from Lésvos and Chíos (Gaskin and Littler 1986) but it is *M. ornata* which is present there (Russell and Pateman 2013c); in fact it is almost certain that all reports of *M. phoebe* from the Aegean Islands should be regarded as *M. ornata* (Russell and Pamperis 2011, 2012).
(2) In Greece *M. phoebe* has not been confirmed as occurring south of Mt. Vardousia, Fokida (Lafranchis pers. obs., ex Pamperis pers. comm.), and is absent from the Peleponnese (Lafranchis 2007).
(3) In Italy *M. phoebe* is not known to occur in southern Calabria, or in Sicily where only *M. ornata* is present (Russell and Pateman 2011: 26, as *telona*); however, Villa et al. (2009: 244) gave the distribution of *M. phoebe* as throughout Italy including Sicily.
(4) In the east *M. phoebe* is absent from Israel, except coastal areas in the North (Benyamini, pers. comm.), southern and eastern Iran and Iraq, except for one record from the extreme northeast (Tshikolovets et al. 2014: 319), although this may refer to the record of Wiltshire (1957: 33), who referred to f. *dorae* and stated that there was only one generation per year, flying in early summer. This suggests that this was most probably not *M. phoebe* but *M. ornata*.
(5) So far as the authors are aware *M. phoebe* is also absent from Jordan, where it is replaced by *M. ornata* (Katbeh-Bader et al. 2003: 17; Wahlberg and Zimmermann 2000: voucher specimen).
(6) It is quite likely that *M. phoebe* is absent from Syria; although Riemis (1993: 93) recorded *M. phoebe* from 50 km south of Aleppo on the road to Damascus, this was before *M. ornata* was separated at species level. The only figured specimens known to the authors from Syria (Van Haeringen 2015) are eight individuals labelled "*M. phoebe telona*" (= *M. ornata*), originating from Bloudan (26.iv.2008), Halbourn (27.iv.2008) and Damascus (5.iv.2010). These specimens exhibit antennal and wing morphological characters typical of *M. ornata* (see Table 1).

Those European regions in which both *M. phoebe* and *M. ornata* have been recorded as being present (although not necessarily sympatric or synchronic) are as follows: France (Var only), Italy (northern Calabria as far north as Campania (Russell and Pateman 2011), Greece (central and north, see above), Macedonia (FYROM) (Verovnik et al. 2010; Verovnik 2012; Russell et al. 2015), Montenegro (Russell 2015), Slovenia (Russell et al. 2014), Hungary (Varga et al. 2005). There are additional reports of the presence of *M. ornata* (unconfirmed) from regions where *M.*

Table 1. Identification difficulties arise in part because of a lack of clear diagnostic features to guarantee separation of adult butterflies; the only apparently constant feature appears to be the colour of late instar larvae. However, there are other features which might aid identification, presented here with an indication of their level of usefulness.

Character	*M. phoebe*	*M. ornata*	*M. punica*	Reliability of character
number of ova in batch	usually more than 100	usually 30–60	data lacking	good
larva L4- final instar head colour	black	red-brown	black	confirms *M. ornata*
final instar larva lateral stripe colour	white (*phoebe phoebe*) orange (*phoebe occitanica*)	no obvious stripe	orange	good (confirms *occitanica* outside North Africa)
distal end of antenna	club shaped	spatulate	variable	fair
shape of forewing apex	acute	rounded	rounded	fair
wing underside background colour	creamy	white	white	fair
hindwing underside premarginal marks	arcuate	triangular	variable, often triangular	poor
premarginal markings touching veins	yes	no	variable, often not touching	fair
voltinism	single to triple brooded	strictly univotine	double to triple brooded	good

phoebe is also known to occur – Croatia (Koren and Štih 2013), Romania (Rákosy and Varga 2001; Székely 2008), Bulgaria (Kolev 2015), and Slovakia (Zitnan pers. comm.). The report by Jakšić (2011: 46–47) of *M. ornata* from Serbia is considered to be dubious; it is not otherwise known from there, and *M. phoebe* is widespread throughout that country. In the east, both species occur in Lebanon and Israel (*M. phoebe* occurs in northern coastal district only; Benyamini, pers. comm.), Turkey (Hesselbarth et al. 1995), the Caucasus (Tshikolovets and Nekrutenko 2012: 293–295; Tikhonov and Russell 2015), the Russian Federation (Russell and Kuznetsov 2012), Syria (but see above), northeast Iraq and northern and western Iran (Tshikolovets et al. 2014). Eisenstein (2000: 190, fig. 234) figured a larva in Israel with a red-brown head feeding on *Centaurea iberica* (Spreng) (*M. ornata*: see also Russell et al. 2007).

The authors see no evidence to support subdivision of *M. ornata* into five subspecies (Tshikolovets 2011: 498–499); previous gaps in the known distribution of this species are rapidly being filled, making recognition of subspecies on a geographical basis increasingly difficult to support. Also, the diverse variety of host-plants used by *M. ornata* is more likely to be dependent on which Asteraceae species are available for use by larvae in any particular locality, rather than any evolutionary preference resulting in development of subspecies. The differing ability of closely related species to metabolise apparently suitable host-plants is also significant (Tóth et al. 2015); however, it is of interest to note that different host-plants were being used by *M. ornata* on the adjacent eastern Aegean Islands of Lésvos and Chíos, where adult butterflies were almost identical (Russell and Pamperis 2011; Russell and Pateman 2013c).

Despite use of the name *punica* by various authors for populations of *M. ornata* in a number of different countries, *Melitaea punica* is entirely confined to North Africa, where it is restricted to Morocco and Algeria; there have been no reports from Tunisia (see Appendix: Note 3).

Synonymic list

Melitaea phoebe abbas Gross & Ebert, 1975 [Note 7] [Type Locality (TL): 50 km. NW Ardkan, Tange Sorkh, Fars, Iran, 2250 m, 12–15.vi.1975].

Melitaea ornata adversaria Korb, Stradomsky & Kuznetsov, 2015 [Note 8] [TL: Kirghizia, Kirghiz Mts., Ala-Too settlement vicinity, 1100–1200 m].

Melitaea phoebe var. ***aetherea*** Eversmann, 1851 [Note 9] [TL: Russia 'au Sud qu'au Nord'].

Melitaea phoebe aethereaeformis Verity, 1919 [Note 10] [TL: central Italy].

Melitaea phoebe alatauica Wagner, 1913 [Note 11] [TL: Issyk-kul, Ili mountains, Kazakhstan].

Melitaea phoebe ab. ***albina*** Verity, 1904 [Note 12] [TL: Lucca, Italy]

Melitaea phoebe allophylus Rütimeyer, 1942 [Note 13] [TL: Porté, Pyrénées Orientales, France].

Melitaea phoebe almana Gaede, 1930 [Note 14] [TL: Elman Dagh N Syria]

Melitaea phoebe alternans Seitz, 1909 [Note 15] [TL: Zermatt, Switzerland].

Melitaea phoebe Knoch var. ***amanica*** Rebel, 1917 [Note 16] [TL: Kushdjula, Taurus Mountains and Das Dagh, Amanus Mountains, Turkey].

Melitaea phoebe rovia autumnalis Fruhstorfer, 1919 [Note 17] [TL: between Brione & Contra, Italy].

Melitaea phoebe ab. ***baccata*** Delahaye, 1909 [Note 18] [TL: Saint-Barthélemy, Maine-et-Loire, France].

Melitaea phoebe Knoch rassa ***bethune-bakeri*** de Sagarra, 1926 [Note 19] [TL: Sierra Nevada, Spain].

Melitaea phoebe Knoch sbsp. n. ***canellina*** Stauder, 1922 [Note 20] [TL: vicinity of Innsbruck, Austria].

Melitaea phoebe capreola Varga, 1967 [Note 21] [TL: Podalia, Kiverci, Ukraine].

Melitaea phoebe var. ***caucasica*** Staudinger, 1870 [Note 22] [TL: "Kindermann ganz ähnliche Stücke im Caucasus fing (?-Helenendorf; Kindermann leg.)"].

Melitaea phoebe caucasicola Verity, 1919 [Note 23] [TL: "Kindermann ganz ähnliche Stücke im Caucasus fing (?-Helenendorf; Kindermann leg.)"].

Melitaea phoebe changaica Seitz, 1909 [Note 24] [TL: Changai Mountains, Mongolia].

Melitaea phoebe ab. ***cinxioides*** Muschamp, 1905 [Note 25] [TL: Switzerland].

Melitaea phoebe Knoch ab. ***confusa*** Joannis, 1908 [Note 26] [TL: Vannes, France].

P.* [*apilio*]** N. Phal. [*Nymphalis Phaleratus*] ***corythallia Esper, [1781] [Note 27] [TL: France (environs of Paris?)]

Melitaea phoebe crassenigra Verity, 1928 [Note 28] [TL: Rozier, Gironde, France].

Melitaea phoebe form ***deleta*** Verity, 1919 [Note 29] [TL: Tuscany, Italy].

Melitaea phoebe Knoch ***dorae*** Graves, 1925 [Note 30] [TL: Nabatea, Petra, Jordan].

Melitaea phoebe tusca emipauper Verity, 1919 [Notes 31 & 96] [TL: Vallombrosa, Tuscany, Italy].

Melitaea phoebe emipunica Verity, 1919 [Note 32] [TL: Palermo district, Sicily, Italy].

Melitaea phoebe mod. ***enoch*** Higgins, 1941 [Note 33] [TL: Askhabad, Turkmenistan].

Melitaea phoebe occitanica f. ***estrela*** Higgins, 1941 [Note 34] [TL: Sierra de Estrela, Portugal]

Melitaea phoebe Knoch ab. ***fasciata*** Galvagni, 1934 [Note 35] [TL: 'Austria Inferior'].

Melitaea phoebe Knoch rassa ***occitanica*** Staudinger 2-gen. ***francescoi*** de Sagarra, 1926 [Notes 5 & 36] [TL: between St. Pere & Vilamajor, Catalonia, Spain, July/August].

Melitaea phoebe gaisericus Hemming, 1941 [Note 37] [TL: Mogador (=Essaouira), Morocco].

Melitaea phoebe galliaemontium Verity, 1928 [Note 38] [TL: Mont Dore, Puy de Dome, France].

Melitaea phoebe gerinia Fruhstorfer, 1917 [Note 39] [TL: Lisbon, Portugal].

Melitaea phoebe ab. ***geyeri*** Aigner-Abafi, 1906 [Note 40] [TL: Szaár (Komitat Fejér), Hungary].

Melitaea phoebe guevara Fruhstorfer, 1917 [Note 41] [TL: Castile, Spain].

Melitaea phoebe Knoch ab. ***gürtleri*** Joukl, 1908 [Note 42] [TL: Plitvička Jezera, Croatia]

Melitaea phoebe occitanica f. ***juliae*** Molina & Ocete, 1986 [Note 43] [TL: Loma de la Amoladera, Guadalcanal (Seville), Spain]

Melitaea phoebe koios Fruhstorfer, 1908 [Note 44] [TL: Klausen, Switzerland].

Melitaea phoebe kovacsi Varga, 1967 [Note 45] [TL: Budakeszi, Hungary].

Melitaea phoebe leechi Rothschild, 1917 [Note 46] [TL: Mogador (= Essaouira), Morocco].

Melitaea phoebe lokris Fruhstorfer, 1908 [Note 47] [TL: Saratov, Russia].

Melitaea phoebe malvida Gaede, 1930 [Note 48] [TL: Meklen Pass, Bosnia].

Melitaea phoebe mandarina Seitz, 1909 [Note 49] [TL: Mongolia].

Melitaea phoebe var. ***melanina*** Bonaparte, 1831 [Note 50] [TL: Monti Subiaco (= Livata), near Santa Scolastica, Arbruzzo, Italy.

Melitaea phoebe minoa Fruhstorfer, 1917 [Note 51] [TL: Engadin, Switzerland].

Melitaea phoebe ab. ***minor*** Wheeler, 1903 [Note 52] [TL: Switzerland].

Melitaea phoebe monilata Verity, 1919 [Note 53] [TL: Wallis (= Valais), Switzerland].

Melitaea phoebe monilataeformis Verity, 1919 [Notes 54 & 96] [TL: Tuscany, Italy].

Melitaea phoebe narenta Fruhstorfer, 1917 [Note 55] [TL: Jablanica, Herzegovina].

Melitaea phoebe nigroalternans Verity, 1919 [Note 56] [TL: Mont Cenis, French/Italian border].

Melitaea phoebe nigrogygia Verity, 1939 [Note 57] [TL: Abbazia = Opatija, Istria, Croatia].

Melitaea phoebe mod. ***nimbula*** Higgins, 1941 [Note 58] [TL: Espinama, Picos de Europa, Cantabria, Spain].

Melitaea phoebe occitanica Staudinger, 1871 [Note 5] [TL: Andalusia, Spain].

Melitaea phoebe ogygia Fruhstorfer, 1907 [Note 59] [TL: Island of Poros, Greece].

Melitaea phoebe ornata Christoph, 1893 [Notes 2 & 6] [TL: *Circa* 'Guberli', promontorium uralensium australium (Guberlya, Orenburg Province, Russian Federation)].

Melitaea phoebe Schiff. ***ornatiformis*** (gen. aestiva) de Sagarra, 1930 [Note 60] [TL: Villacabras, Cuenca, Spain].

Melitaea phoebe ottonis Fruhstorfer, 1917 [Note 61] [TL: "Kindermann ganz ähnliche Stücke im Caucasus fing (?-Helenendorf; Kindermann leg.)"].

P.* [*apilio*]** NP ***Paedotrophos Bergsträsser, 1780 [Note 62] [TL: Hanau-Münzenberg, Germany]

Melitaea phoebe subsp. ***parascotosia*** Collier, 1933 [Note 63] [TL: Sutschan, Russian Federation].

Melitaea phoebe ab. ***parva*** Gerhard, 1882 [Note 64] [TL: Fünfkirchen (= Pecs), Hungary].

Melitaea phoebe var. ***parva*** Caradja, 1895 [Note 65] [TL: Bucharest, Romania].

Melitaea phoebe pauper Verity, 1919 [Notes 66 & 96] [TL: Florence, Italy].

P.* [*apilio*] *phoebe Denis & Schiffermüller, 1775 [Notes 1, 4 & 6] [TL: environs of Vienna, Austria].

Melitaea phoebe phoebina Turati, 1919 [Note 67] [TL: Aspromonte Mountains, Calabria, Italy].

Melitaea phoebe postnarenta Verity, 1939 [Note 68] [TL: St. Dionisio, Mt. Olympos, Greece].

Melitaea phoebe postogygia Verity, 1939 [Note 69] [TL: Salonica (= Thessalonica), Greece.

Melitaea phoebe virgilia postvirgilia Verity, 1950 [Notes 70 & 100] [TL: Vence, Alpes-Maritimes, France].

Melitaea phoebe pseudosibina Alberti, 1969 [Note 71] [TL: Mt. Elbrus, Itkol, Kabardino-Balkaria, Russia].

Melitaea phoebe punica Oberthür, 1876 [Notes 3 & 6] [TL: Tazoult-Lambèze (Lambessa), Algeria].

Melitaea phoebe punica-powelli Oberthür, 1915 [Note 72] [TL: Algeria].

Melitaea phoebe forma ***punicata*** Ragusa, 1919 [Note 73] [TL: Sicily, Italy].

Melitaea ornata reliquiae Korb, Stradomsky & Kuznetsov, 2015 [Note 74] [TL: Russia, Volgograd Province, Olkhovsky distr., Kamenny Brod].

Melitaea phoebe rostagnoi Turati, 1920 [Notes 75 & 96] [TL: Rome, Italy].

Melitaea phoebe rovia Fruhstorfer, 1919 [Note 76] [TL: Monte Generoso, Maroggia, Tessin, Switzerland].
Melitaea phoebe f. ***rubialesi*** Gómez Bustillo, 1973 [Note 77] [TL: Loeches (Madrid), Spain]
Melitaea phoebe forma ***rubrofasciata*** Gušić, 1922 [Note 78] [TL: Podsused, nr. Zagreb, Croatia].
Melitaea phoebe Knoch ***sarvistana*** Wiltshire, 1941 [Note 79] [TL: Sarvistan, SE of Shiraz salt lake, Iran].
Melitaea phoebe var. ***saturata*** Staudinger, 1892 [Note 80] [TL: Kentai Mountains, Mongolia].
Melitaea phoebe ab. ***seminigra*** Delahaye, 1909 [Note 81] [TL: Pignerolles, Maine-et-Loire, France].
Melitaea phoebe Knoch var. ***sextilis*** Jachontov, 1909 [Note 82] [TL: Zheleznovodsk, Stavropol Krai, Russian Federation (North Caucasus)].
Melitaea phoebe Knoch var. ***sibina*** Alphéraky, 1881 [Note 83] [TL: Kuldjà, Ili Valley, China].
Melitaea phoebe rostagnoi ab. ***sterlineata*** Turati, 1920 [Note 84] [TL: Monte Autore (Province of Rome), Italy].
Melitaea phoebe streltzovi Kolesnichenko & Yakovlev, 2004 [Note 85] [TL: Western Mongolia, Hovd aimak, 30 km north-northwest from Bulgan somon, junction of Bajan-Gol and Bulgan-Gol rivers, 1500 m 11–13 August 2003].
Melitaea phoebe subcorythallia Verity, 1928 [Note 86] [TL: Auzay, Vendée, France].
Melitaea phoebe suboccitanica Verity, 1928 [Note 87] [TL: Auzay, Vendée, France].
Melitaea phoebe subtusca Verity, 1952 [Notes 88 & 96] [TL: Nans-les-Pins, St. Baume, Var, France].
Melitaea phoebe sylleion Fruhstorfer, 1917 [Note 89] [TL: Cogne, Piedmont, Italy].
Melitaea phoebe tatara Krulikovsky, 1891 [Note 90] [TL: Casanum = Kazan or Casan, Republic of Tatarstan, Russian Federation].
Melitaea phoebe telona Fruhstorfer, 1907 [Note 91] [TL: Jerusalem, Palästina (Israel)].
Melitaea phoebe *forma* ***totila*** Stauder, 1914 [Note 92] [TL: Monte Cocuzzo, Consenza, Calabria, Italy].
Papilio tremulae Piller & Mitterpacher, 1783 [Note 93] [TL: between Drau & Sawe, Croatia].
Melitaea phoebe tungana Seitz, 1909 [Note 94] [TL: "Sajan District", Russian Federation].
Melitaea phoebe tungusa Herz, 1899 [Note 95] [TL: Witim & Vilui mountains, Siberia, Russian Federation].
Melitaea phoebe tusca Verity, 1919 [Note 96] [TL: Tuscany, Italy].
Melitaea phoebe var. ***occitanica*** ab. ***uclensis*** Melcón, 1910 [Note 97] [TL: Uclo, Cuenca, Spain].
Melitaea phoebe ufensis Krulikovsky, 1902 [Note 98] [replacement name for ***uralensis*** [Note 99]].
Melitaea phoebe uralensis Krulikovsky, 1897 [Note 99] [TL: district of Ufa, Russia].
Melitaea phoebe virgilia Fruhstorfer, 1917 [Note 100] [TL: Alpes Maritimes, France].
Melitaea phoebe wagneri Wnukowsky, 1929 [Notes 11 & 101] [replacement name for ***alatauica*** Wagner].
Melitaea phoebe scotosia yagii Nire, 1917 [Note 102] [TL: *c.* 5 km west of Mt. Asama, Shinano Province, Japan].
Melitaea zagrosi Tóth & Varga, 2011 [Note 103] [TL: Zagros Mountains, Iran].

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Appendix

Note 1. ***Melitaea phoebe*** (Denis & Schiffermüller, 1775) [Type Locality (TL): environs of Vienna, Austria]: type material lost; neotype ♂ designated by Tennent and Russell (2010), reared from larva collected from near Vienna, Austria. An often double or even triple brooded species.

Note 2. ***ornata***: (***Melitaea ornata***) Christoph, 1893 [TL: *Circa* 'Guberli', promontorium uralensium australium (near Guberlya, Orenburg Province, Russian Federation)]: this taxon was first recognised as a species distinct from *phoebe* by Tóth and Varga (2011), based on morphometric measurements of male and female genitalia. It was discovered in the Volgograd region at Ilovlya by Tuzov and Churkin (2000: 73, pl. 46, figs 7–9 & 15–17) who wrongly used the name *M.* (*phoebe*) *punica*; Kuznetsov and Stradomsky (2010) subsequently used the name *Melitaea telona*. Kuznetsov (2011) provided details of the biology of this taxon and Russell and Kuznetsov (2012: figs 1–3) demonstrated that larvae from the Volgograd region had red-brown heads. This character is diagnostic for *M. ornata* (within the *Melitaea phoebe* species group – *M. cinxia* larvae also have red-brown heads).

The colourful adults were illustrated by Higgins (1941: pl. 14, fig. 10), Gorbunov and Kosterin (2007: 2: 84, figs 197, 198) and van Oorschot and Coutsis (2014: pl. 12: figs 20, 21 & pl. 13: figs 2, 3). *M. ornata* contrasts with the less colourful *M. phoebe* flying at the same localities in the southern Ural Mountains (present authors, pers. obs.). Tshikolovets (2011: 498) and Tshikolovets et al. (2014: 319) recognised *ornata* as a distinct species. The fact that van Oorschot and Coutsis (2014: 60) placed *ornata* as a synonym of nominotypical *phoebe* is in part what prompted the present paper. The first author has reared many hundreds of specimens of both *phoebe* and *ornata* from many localities in Europe and both authors have seen adults of the two species (sympatric but not synchronic) flying in the Urals. There can be no doubt whatever that *Melitaea phoebe* and *Melitaea ornata* (=*telona*: see Note 91) are distinct species, with different early stages, voltinism (*M. ornata* is invariably single brooded *M. phoebe* often double or triple brooded) and they often have different host-plants.

Recognition of *ornata* as a distinct species paved the way for the realisation that what had recently been referred to as "*emipunica*" (Russell et al. 2005), "*ogygia*" (Varga et al. 2005) and "*telona*" (Kuznetsov and Stradomsky, 2010) all represented the same species (*i.e. ornata*).

Note 3. ***punica***: (***Melitaea punica***) Oberthür, 1876 [TL: Tazoult-Lambèze (Lambessa), Algeria]: This species was described by Oberthür (1876: 25) as a subspecies of *M. phoebe*, but Oberthür himself subsequently raised it to the status of a distinct species (Oberthür 1914: 102). It is now recognised as a distinct species by most modern authors. Following the unfortunate introduction of a quadrinomen "*M.* (*phoebe*) *punica telona*" (this actually encompassed three distinct species: *phoebe*, *punica* and *ornata* [as *telona*]) by Hesselbarth et al. (1995: 1030), the status of *punica* became very confused. It was repeated in that form by Koçak (2000: 9), and a number of authors (e.g. Koçak and Seven 1998: 4) used the combination "*Melitaea punica telona*". Nazari (2003) placed all the taxa mentioned (including *telona* but not *punica*) as synonyms of *M. phoebe*, with the rather unhelpful note: "For further synonymy see Higgins (1941: 338–343)".

Subsequently, and presumably as a direct result of the action by Hesselbarth et al. (1995: 1030), the name *punica* was frequently wrongly associated with the name *telona* Fruhstorfer, 1908 (see also Note 2). For example Abadjiev (2000, 2001: 271), Tuzov and Churkin (2000: 73, pl. 46, figs 7–9, 15–17), Rákosy and Varga (2001), Gorbunov and Kosterin (2003 2: 84) and more recently Baytaş (2007: 128), Székely (2008: 175), Aghababyan (2012: 13), Hüseyinoğlu and Akyol (2013: 11 & 14) and Hüseyinoğlu (2013: 1293), all used

the combination '*Melitaea* (*Cinclidia*) (*phoebe*) *punica*' for the taxon *ornata*. This confusion was undoubtedly brought about by the fact that the underside hindwing pattern (particularly in the submarginal area) of *M. punica* (*cf.* Russell et al. 2006: figs 12–26) is very similar to those non-*phoebe* specimens from Europe and Turkey. This was clearly demonstrated by Russell and Pamperis (2011: 140–142 & figs 3–8; 2012) and Russell and Pateman (2012: figs 4–7). Other authors simply used the name *punica* for the species which was not *M. phoebe s.s.*: *e.g*. Leraut (1999: 173), who gave the distribution of "*C*[*inclidia*] *punica*" (*i.e. Melitaea punica*) as Italy to Turkey and Jordan, with no mention of North Africa, the TL of *punica* and the only place where *M. punica* is actually known to occur.

More recently, Tóth and Varga (2011) and van Oorschot and Coutsis (2014: 66) separated *punica* from *phoebe* on the basis of differences in the male genitalia, and this was followed by Tshikolovets (2011: 497). Collectively, the published literature during the last two decades has created substantial confusion which, insofar as it affects *M. punica*, is clarified here: *Melitaea punica* is confined to North Africa; it occurs from the Atlantic coast of Morocco throughout the Atlas and Rif Mountains to eastern Algeria but apparently not into Tunisia (Tennent 1996: 52). The larva is very similar to that of *M. phoebe occitanica* (Note 5) (Russell et al. 2006: figs 1–4 & 6); however, *punica* butterflies in North Africa are quite different in appearance to *phoebe occitanica* in Spain (*cf.* Higgins 1941: pl. 14, figs 6 & 11; Russell et al. 2006: figs 8–26; Tolman and Lewington 2008: 203).

Note 4. ***Melitaea phoebe phoebe***: The body of the final instar larva of *M. phoebe phoebe* is black, including the head carapace, with black or orange tubercles and white spots spaced around each segment; these spots usually coalesce on each side to form an often prominent lateral white line (see Table 1; also Bodi 1985: plate XI, fig. 92; Lafranchis 2000: 391, fig.; Russell et al. 2007: 159, fig. 14; Lafranchis 2007a: 41, fig. 13; Lafranchis 2008: 6 (fig.); Tennent and Russell 2010: 151, fig. 9). Its distribution ranges from the Ural Mountains to *c.* 60º N., through the Caucasus, south to Iraq, Iran and Lebanon, reaching its southern limit in northern Israel (Benyamini pers. comm.), westwards through Turkey, the Balkans, Hungary, Austria, southern Germany and the alpine and sub-alpine regions of France, Switzerland and Italy.

Some of the name bearing types originate from the eastern Palaearctic. For the sake of completeness these have been included. They are synonymised with nominotypical *phoebe* due to the fact that Kosterin (see Korshunov and Gorbunov 1995) described a final instar larva of *M. phoebe* from near Zabaikalye (south-eastern Russia) as follows: "white with fine black reticulate ornament, so that looks grey; this ornament fuses into a black line along the back and a more diffuse line on either side (between 2nd and 3rd row of false spines from beneath); a white stripe (without ornament) goes through 2nd row beneath false spine row. Thoracic legs and ventral prolegs yellowish-grey; head greyish-black, set with tiny black hairs". This description precisely matches that of the final instar larvae of the European populations of nominotypical *phoebe*. Adult butterflies are very variable, and we are unable to separate populations of *phoebe s.s*. in western Europe to the Urals into distinct races (subspecies).

Note 5. ***Melitaea phoebe occitanica*** Staudinger, 1871 [TL: Andalusia, Spain]: the Type Locality of this subspecies was given originally by Staudinger as "It" (= Italy?) but it is now generally accepted that this was an error (*recte* 'Iberia': Higgins 1941: 336); Verity (1928: 163) limited the Type Locality to Barcelona, Spain, and this was accepted by van Oorschot and Coutsis (2014: 60). Previously, however, Fruhstorfer (1916: 82 (A) (2): 1) was of the opinion that the source of the *occitanica* phenotype was Andalusia and Higgins (1941: 336) considered that this should stand, based on the original description by Staudinger, who did not specify a 'Type' but labelled the series upon which the description was based with the word '*original*' (Higgins 1941:

336). The body of the final instar larva of *M. phoebe occitanica* is black, including the head, with obscure white spots on the body, black tubercles dorsally and a row of orange tubercles with orange hairs laterally, which form an obvious orange lateral line (Lafranchis 2000: 388, fig.; Maravalhas 2003: 281, fig.; Russell et al. 2007: 159, fig. 13; Lafranchis et al. 2015: 464–467, figs), in contrast to the white lateral line of nominotypical *phoebe* (see Table 1, and Note 4).

This subspecies has also been separated from nominotypical *phoebe* using the results of enzyme electrophoresis by Pelz (1995: 57), who was of the opinion that genetic differences were sufficiently significant for *occitanica* to be considered as a "semispecies". This subspecies is distributed from the Iberian Peninsula eastwards through France and peninsular Italy as far south as northern Calabria (Russell pers. obs.); it has also been found in Istria, Croatia (Russell and Pateman 2013a: 47, fig. 6).

Tshikolovets (2011: 496) suggested that the distribution of this subspecies included northern Greece, the southern and eastern parts of the Balkans, western Turkey and Ukraine. The present authors do not agree and consider that these areas are occupied by nominotypical *phoebe*; larvae from Romania, for example, are clearly of the 'white lateral stripe form' associated with nominotypical *phoebe* (Russell et al. 2007: 159, fig. 13). Where the two subspecies meet, for example in Var, France and Istria, Croatia, the larvae can be intermediate in form, as one might expect (Russell and Pateman 2013: 47, figs 8, 9). The colourful adult has been illustrated by many authors, including Higgins (1941: pl. 14, fig. 11), Manley and Allcard (1970: plate 10, figs 1–7) and Lewington in Tolman and Lewington (1997: plate 50).

Note 6. The species ***phoebe, punica, ornata***: despite a series of articles (e.g. Russell et al. 2005, 2006, 2007), Tolman and Lewington (2008: 202–203) recognised only one species *M. phoebe.* However, all three species were separated using DNA sequences by Lenevue et al. (2009) and Tóth et al. 2014. Recognition of these distinct species is now accepted by most recent authors (Tshikolovets 2011: 496–499; Tóth and Varga 2011; van Oorschot and Coutsis 2014: 60–64 & 66), although not necessarily using correct species and/or subspecies names in the correct combinations. The *raison d'être* for this paper is to resolve this nomenclatural muddle.

Note 7. ***abbas*** Gross & Ebert, 1975: 44, fig. 61: synonym of ***Melitaea ornata***. Tshikolovets et al. (2014: 320, map) gave this taxon subspecific status of *M. ornata* and stated that it was found in west and south Iran. Their figures (Plate LX: figs 7, 8, 10, 11 & 12) depicted specimens which appear to have spatulate antennae and black arched submarginal underside hindwing markings not touching the intervening veins, both features typical of *M. ornata* (see Table 1). Subsequently, van Oorschot and Coutsis (2014) figured 5 specimens (plate 13: figs 8, 11, 12, 13 & 16), all from western Iran, of *M. ornata* (as *M. telona*).

Note 8. ***Melitaea ornata adversaria*** Korb, Stradomsky & Kuznetsov, 2015: 142 & plate VI: tentative synonym of ***Melitaea ornata.*** This material has been classified as both *Melitaea phoebe saturata* (Korb 2011: 158: see Note 80) and *Melitaea ornata adversaria* (Korb et al. 2015). The latter was based on molecular analysis of the preserved specimens and we Note that Korb et al. (2015: 142) considered that *M. phoebe* was not present in the Kyrghyz Mountains. The flight period was given (Korb 2011: 158) as May–July, at elevations between 500 and 2000 m; we consider that July is likely to be beyond the flight time of *M. ornata* and that larvae would be in diapause by the end of June. So far as we are aware, larvae of the *Melitaea* populations in this region have not been reported; our synonymy is thus tentative, pending further data.

Note 9. ***aetherea*** Eversmann, 1851: 5: 73 and plate IX: figs 5, 6: synonym of **nominotypical *phoebe***. Synonymised with *M. phoebe* by Higgins (1941), and followed by van Oorschot and Coutsis (2014: 60). A

large but weakly marked form (Higgins 1941: 338, plate 14: fig. 9). Korshunov and Gorbunov (1995: species 174) gave a very full description of the larva of this form, which clearly associated it with nominotypical *phoebe*. Tshikolovets (2011: 497) used this name at subspecies rank.

Note 10. ***aethereaeformis*** Verity, 1919: 183: synonym of ***phoebe occitanica***. Specimens from central Italy which were similar in appearance to *aetherea* Eversmann, 1851 (Higgins 1941: 338) were due to its geographical location placed with *occitanica*. Overlooked by van Oorschot and Coutsis (2014).

Note 11. ***alatauica*** Wagner, 1913, vol. 2: 89 (fig.): Junior primary homonym of *M. parthenie alatauica* Staudinger, 1881, and presumed synonym of **nominotypical *phoebe***. The authors consider that this name is most probably related to *M. phoebe* since it occurs in the eastern Palaearctic outside the presently known eastern limit of the distribution of *M. ornata* (see introduction). Placed with *M. phoebe* by van Oorschot and Coutsis (2014: 60), who suggested that it could be synonymous with *M. sibina* Alphéraky, 1881 (see Note 83).

Note 12. ***albina*** Verity, 1904: 54: we cannot place this form with either *M. phoebe* or *M. ornata*. An aberrant individual having the ground colour of the right hindwing yellowish-white (Higgins 1941: 339); both species may occur in the Lucca region of Italy.

Note 13. ***allophylus*** Rütimeyer, 1942: 438: synonym of ***phoebe occitanica***. Higgins (1955: 118) recognised this form as "leading to *occitanica* Staudinger" and suggested that it should be synonymised with *M. corythallia* Esper, 1781 (*i.e. phoebe occitanica*, see Note 27).

Note 14. ***almana*** Gaede, 1930: 208: probable synonym of ***Melitaea ornata***. This name, attributed to Rebel, appears to have been first published by Gaede under *M. phoebe* (in Seitz, Supplement). Neither Higgins (1941: 339) nor the present authors were successful in their efforts to find an original Rebel reference, and as a result it is provisionally treated as a Gaede manuscript name. Gaede stated that it was a pale race from Asia Minor similar to *M. telona* (*i.e. ornata*). Hesselbarth et al. (1995: 1031) referred to Graves (1925: 101), who stated that this form came from Elma Dagh, Syria. They suggested that it may have been a misspelling of *amanica* Rebel (see Note 16) and synonymised it with *Melitaea punica telona* (*i.e. ornata*), although it is Noted that Gaede treated both names separately. Not mentioned by van Oorschot and Coutsis (2014).

Note 15. ***alternans*** Seitz, 1909: 216: synonym of **nominotypical *phoebe***. A large brightly coloured subalpine form; not figured by either Seitz (1909) or Higgins (1941) but figured by Tolman and Lewington (1997: plate 50; 2008: 203 [same painting]); Higgins (1941: 339) suggested that it was 'proceeding to *occitanica* Staudinger' but only because of its brighter colouring, which is typical of both Alpine and Spanish specimens. See also *monilata* (Note 53).

Note 16. ***amanica*** Rebel, 1917: 252: synonym of ***Melitaea ornata***. Tshikolovets and Nekrutenko (2012: 295) synonymised this form with *telona*, placing the latter as a subspecies of *M. ornata*, and recorded its distribution as the Lesser Caucasus, Djavakheti-Armenian plateau and Talysh. The form is univoltine, with a flight period of May (sometimes late April) – June. Tuzov et al. (2000: plate 46: figs 7–9) figured three specimens in colour with the legends: "*Melitaea* (*phoebe*) *punica amanica* Rebel", two from Armenia, Azavan and one from Azerbaijan, Talysh Mts, Zuvand Plateau, Gosmalyan, 1500 m, 4.vi.1981. Antennal clubs of these specimens appear short and the hindwing underside markings in the submarginal area appear similar to those

of *M. ornata*. Van Oorschot and Coutsis (2014: plate 13, fig. 7) figured in colour a specimen from Armenia, Vedi, vicinity of Chosrov, 27.v.1974, under the name *M. telona* (*i.e. ornata*), which appears from its underside hindwing markings to be correct.

Note 17. ***autumnalis*** Fruhstorfer, 1919: 169: synonym of **nominotypical *phoebe***. The second generation form of *rovia* Fruhstorfer, 1919 (see Note 76). Bernardi and de Lesse (1951: 141) identified a holotype for *autumnalis* (as *automnalis*).

Note 18. ***baccata*** Delahaye, 1909: 10: aberration of ***phoebe occitanica***. The supplement in which this name was published was not available to Higgins (1941: 339), but was kindly supplied to the authors by Eric Drouet. The name refers to an aberrant female specimen which was taken in August at Saint-Barthélemy, Maine-et-Loire in west-central France and thus outside the known ranges of both nominotypical *phoebe* and *M. ornata*. Not mentioned by any recent author.

Note 19. ***bethunebakeri*** de Sagarra, 1926: 130: synonym of ***phoebe occitanica***. Higgins (1941: 339) correctly considered it synonymous with *occitanica* Staudinger 1871. Not mentioned by van Oorschot and Coutsis (2014).

Note 20. ***canellina*** Stauder, 1922: 18: synonym of **nominotypical *phoebe***. Higgins (1941: 339) suggested this was synonymous with *minoa* Fruhstorfer, 1917 (see Note 51); the TL places it outside the known ranges of both *phoebe occitanica* and *ornata* but within the distribution of nominotypical *phoebe*. Overlooked by van Oorschot and Coutsis (2014).

Note 21. ***capreola*** Varga, 1967: 131: synonym of ***Melitaea ornata***. Varga described this as a subspecies of *M. phoebe*, but subsequently (Tóth and Varga 2011) placed it with *M. ornata*; van Oorschot and Coutsis (2014: 63) placed it with *M. telona* (*i.e. ornata*).

Note 22. ***caucasica*** Staudinger, 1870: 59, Taf. 1 fig. 2: synonym of **nominotypical *phoebe***, but name preoccupied by *M. didyma caucasica* Staudinger, 1861; see *ottonis* Fruhstorfer, 1916 (a replacement name for *caucasica*: Note 61), and *caucasicola* Verity, 1919 (Note 23), a later replacement name. A lectotype ♀ and a paralectotype ♂ were designated by Nekrutenko (Hesselbarth et al. 2: 1028) from the Staudinger collection, housed at Zoologisches Museum der Humboldt Universität, Berlin.

Note 23. ***caucasicola*** Verity, 1919: 184: a replacement name for *caucasica* Staudinger, 1870 (see Note 22); a junior subjective synonym of *ottonis* Fruhstorfer, 1916 (see Note 61).

Note 24. ***changaica*** Seitz, 1909: 217: synonym (provisional) of **nominotypical *phoebe***. Occurs in the eastern Palaearctic, further east than the presently known eastern limit of the distribution of *M. ornata*. Kosterin figured a final instar larva of this taxon from 10 km NNW of the village of Tasyrkhoi S Chita region (Dahuria), Transbaikalia, Siberia, Russia, 19.vi.1995. Its black head carapace confirms probable synonymy with *M. phoebe*.

Note 25. ***cinxioides*** Muschamp, 1905: 69 (fig.): aberrational form of **nominotypical *phoebe***. Its origin in Switzerland is outside the distributional areas of both *phoebe occitanica* and *M. ornata*. An aberrant form with black spots in the submarginal brown spots of the hindwing upperside, resembling *M. cinxia*. This recurrent

aberration is known to occur almost anywhere (pers. obs.). Placed with *M. phoebe* by Higgins (1941: 339). Not mentioned by any recent authors.

Note 26. ***confusa*** Joannis, 1908: 45: synonym of ***phoebe occitanica***. An aberrant ♂ form in which the upperside forewings are more reddish with the black markings reduced, the transverse black lines in the discal region are nearly obliterated and the hindwings are dark basally. The underside forewings have similar markings but the hindwings are yellowish white with enlarged dark markings. Higgins (1941: 339) attributed this name to Oberthür but with Joannis' reference, and he did not correct this in his *errata* (Higgins 1944). The TL of Brittany, northwest France, places it outside the known ranges of nominotypical *phoebe* and *M. ornata*. Not mentioned by any recent authors.

Note 27. ***corythallia*** Esper, [1781]: 65, 67, Taf. 61, figs 4, 5: synonym of ***phoebe occitanica***. Verity (1928: 163) was of the opinion that *occitanica* Staudinger (see Note 5) should be placed as a synonym of *corythallia* Esper, on the basis that he believed the specimens representing *corythallia* originated from the Iberian Peninsula. Higgins (1941: 336) disagreed with this course of action and showed that Verity's assumption was incorrect, as Esper ([1781]: 67), stated that they were the original specimens of Geoffroy's *Papilio cinxia* var. *B*, which were from France (Higgins 1941: 336). Whether the origin of the specimens of *corythallia* were from France or Spain is unimportant because the same subspecies of *M. phoebe* (*i.e. occitanica*) occurs in both countries. Hesselbarth et al. (1995: 1028) and van Oorschot and Coutsis (2014: 60), synonymised this name with *M. phoebe*. Although the name *corythallia* predates *occitanica*, type material of the former appears to be lost (Hesselbarth et al. 1995: 1028) and the name *occitanica* has been used extensively by authors in referring to *phoebe* populations from the Iberian Peninsula. The present authors have followed this course of action.

Note 28. ***crassenigra*** Verity, 1928: 162: synonym of ***phoebe occitanica***. An *occitanica* form with heavy discal spotting from southwest France (Higgins 1941: 339).

Note 29. ***deleta*** Verity, 1919: 184: aberration of (presumably) ***phoebe occitanica***. Aberrant female of form *tusca* (see Note 96) with almost all the black markings obliterated (Higgins 1941: 339). Larvae reared from populations of *M. phoebe* from peninsular Italy have, so far as the authors are aware, all been of the *occitanica* form (see Note 5).

Note 30. ***dorae*** Graves, 1925: 100: synonym of ***Melitaea ornata***. Graves (1925: 103–106) gave a two page description of this form, and a table of "Index of Nigrescence of *M. phoebe* races (upperside)", which demonstrated that it was paler than either *telona* or *ogygia*. Higgins (1941: 339) paraphrased this description as "small and pale, with the black markings fine and partly obsolete"; this is typical of phenotypes in xerothermic biotopes. Hesselbarth et al. (1995: 1031) synonymised this name with '*M. punica telona*' (*i.e. ornata*) and Tshikolovets (2011: 499) with '*Melitaea ornata telona*' (*i.e. ornata*). Van Oorschot and Coutsis (2014: 63) synonymised this with *M. telona* (*i.e. ornata*) and illustrated (van Oorschot and Coutsis 2014: plate 13, fig. 6) a specimen from Wadi Zarqa, Jordan, 400 m, the underside hindwing pattern and spatulate antennae of which suggest synonymy with *ornata*.

Note 31. ***emipauper*** Verity, 1919: 184: synonym of ***phoebe occitanica***. Described by Verity as a medium sized, summer brood form of *tusca* Verity, 1919 (Higgins 1941: 340) (see Note 96).

Note 32. ***emipunica*** Verity, 1919: 184: synonym of ***Melitaea ornata***. This name was used by Russell et al. (2005) when the species was first identified as being distinct from *M. phoebe* by the red-brown head colour of the stage L4 to the final instar larvae, reared from a female taken at Montagna Longa, within the Type Locality (*i.e.* Sicily). This was afforded subspecific status by Tshikolovets (2011), with a distribution given as SE France (Var), Sicily and S Italy (Calabria, Basilicata, Campania). It was synonymised with *M. telona* (*i.e*. *ornata*) by van Oorschot and Coutsis (2014: 63). Brief use of *emipunica* by Russell et al. (2005) and of *ogygia* by Varga et al. (2005) was before the wide distribution of *M. ornata* was fully appreciated, and was (in part) the cause of ensuing confusion.

Note 33. ***enoch*** Higgins, 1941: 337: synonym of ***Melitaea ornata***. Figured by Higgins (1941: plate 14, fig. 4), who gave other locations for this form: Arwas and Achal Tekke, 2000 m, July, and Jablonowka from the same region (Transcaspia). He placed it with *M. phoebe occitanica* but suggested that this placement was due to the colour contrast of the wings being similar to, but not quite so strongly marked as, those of 'Spanish *occitanica'*. Higgins further noted a slight difference in male genitalia and suggested the possibility that *enoch* should be ranked as a subspecies of *M. phoebe*. Tshikolovets et al. (2014: 319 and plate LX: figs 6 and 9) placed *enoch* as a subspecies of *M. ornata*. Van Oorschot and Coutsis (2014: 63) placed it as a synonym of *M. telona* (*i.e*. *ornata*).

Note 34. ***estrela*** Higgins, 1941: 337: ***phoebe occitanica***. Said by Higgins (1941: 337) to be: "very bright … labelled *estrela* Romei, but I cannot trace a reference to a description, and do not know whether the name was ever published validly …"; the present authors have also failed to find a published reference by Romei, and place the name as a *nomen nudum*.

Note 35. ***fasciata*** Galvagni, 1934: 2: an aberration of **nominotypical *phoebe***. This extreme aberration has the upper surface of the wings almost black with the forewing discal macules radially elongated into a fascia. The specimen was taken on 6.viii.1933 near Vienna; its origin places it with nominotypical *phoebe*. The name has been used by a number of authors to describe specimens in which the black markings coalesce to form fasciae; for example Wiltshire (1946: 26; plate 3, fig. d) used it to describe a specimen of *M. phoebe* from Shiraz, Fars, SW Iran, suggesting it was similar to "mod. or ssp. *telona*" (= *ornata*).

Note 36. ***francescoi*** de Sagarra, 1926: 130: synonym of ***phoebe occitanica***. A name raised for specimens of the second brood of *occitanica* Staudinger, 1871, flying in July/August (Higgins 1941: 340) (see also Note 5).

Note 37. ***gaisericus*** Hemming, 1941: 207: synonym of ***Melitaea punica***. A replacement name for *leechi* Rothschild (see Note 46) (Higgins 1941: 340); Higgins (1941: pl. 15, fig. 8) figured an example from Azrou, Morocco. Synonymised with *M. punica* by van Oorschot and Coutsis (2014: 66).

Note 38. ***galliaemontium*** Verity, 1928: 162: synonym of ***phoebe occitanica***. A name raised for small, second brood specimens (Higgins 1941: 340) from France. Overlooked by van Oorschot and Coutsis (2014).

Note 39. ***gerinia*** Fruhstorfer, 1917: 1: synonym of ***phoebe occitanica***. This form is more uniform in colour than the contrasting highly coloured form found in Spain (Higgins 1944: 340) (see Note 15). In raising the name *gerinia*, Fruhstorfer (1917: 1–2) did not refer to specimens he had seen, as a result of which Bernardi and de Lesse (1951: 141) were unable to identify syntypes.

Note 40. ***geyeri*** Aigner-Abafi, 1906: 208: **status uncertain**. It is not possible to synonymise this aberrant male with either *M. ornata* or nominotypical *phoebe*, since both fly in Hungary (*cf.* Varga 1967; Varga et al. 2005). This name was credited to Abafi-Aigner (sic) by Higgins (1941: 340).

Note 41. ***guevara*** Fruhstorfer, 1917: 19: synonym of ***phoebe occitanica***. A lightly marked form from Spain with pale yellow ground colour, markings reduced on both wing surfaces (Higgins 1941: 340). It was synonymised by van Oorschot and Coutsis (2014: 61) with *M. phoebe*; its origin suggests it is synonymous with *phoebe occitanica* (see also Note 19).

Note 42. ***gurtleri*** Joukl, 1908: 97: **status uncertain**. This name was based on a single aberrant specimen, with a bright orange ground colour on the upper surface of the wings and underside wing bases that were said to be very dark. This sounds like *M. ornata* rather than *M. phoebe*, but the presence of *M. ornata*, although reported from Croatia (Koren and Štih 2013) has yet to be confirmed there. *M. phoebe* is certainly present further north than the Plitvice Lakes [TL], in Istria (Russell and Pateman 2013a, b). Overlooked by van Oorschot and Coutsis (2014).

Note 43. ***juliae*** Molina & Ocete, 1986: 869: form of *Melitaea phoebe occitanica*.

Note 44. ***koios*** Fruhstorfer, 1908: 194: synonym of **nominotypical *phoebe***. Holotype examined by Bernardi and de Lesse (1951: 141) from specimens in the Museum National d'Histoire Naturelle de Paris (MNHN). Van Oorschot and Coutsis (2014: 60) gave the TL as: "Italy (S Tyrol), Switzerland (Klausen)". Higgins (1941: 340) synonymised this large and rather dark form with nominotypical *phoebe*, and this was followed by van Oorschot and Coutsis (2014: 60).

Note 45. ***kovacsi*** Varga, 1967: 131: synonym of ***Melitaea ornata***. This form has been placed in various combinations, including *M. ogygia kovacsi* (Varga et al. 2005) and *M. ornata kovacsi* (Tóth and Varga 2011). The post diapause larvae have red-brown heads (Varga et al. 2005: 67, fig. 2; Russell et al. 2007: 159, fig. 18). The present authors can find no significant morphological features to separate *kovacsi* from nominotypical *ornata*.

Note 46. ***leechi*** Rothschild, 1917: 99: ***Melitaea punica***. A junior primary homonym of *Melitaea leechi* Alphéraky, 1895 (van Oorschot and Coutsis 2014: 66) (see also Note 37).

Note 47. ***lokris*** Fruhstorfer, 1908: 194: synonym of **nominotypical *phoebe***. The upperside black pattern is more extensive than that of *ottonis* Fruhstorfer, 1916 (see Note 61) (Higgins 1941: 340). Type material was examined by Bernardi and de Lesse (1951: 141) from specimens in the MNHN, Paris.

Note 48. ***malvida*** Gaede, 1930, *in* Seitz (Supplement: 207, fig. 13d): presumed synonym of **nominotypical *phoebe***. Gaede attributed this name to Fruhstorfer, but without a date; unable to find an original Fruhstorfer reference, Higgins (1941: 340) attributed it to Seitz (we have also failed to find any original Fruhstorfer reference, but we note that the *Melitaea* section of Seitz' Palaearctic supplement was by Gaede, not Seitz). Gaede noted that *malvida* had pointed forewings, suggesting a form of *phoebe* rather than of *ornata* and suggested an association with form *narenta* (see Note 55). He also illustrated (in Seitz 1930, Supplement: plate *Neptis-Argynnis*, fig. d: 5) the upperside, which is not helpful for identification. Although Tóth et al. (2014: 752, fig. 1, map) indicated the presence of *M. ornata* in Bosnia, no locality in Bosnia was given in their specimen

list (Tóth et al. 2014: 751, table 1); the present authors are not aware of any modern records of *ornata* from Bosnia, and a TL of Bosnia suggests synonymy with nominotypical *phoebe*. Thurner (1964: 34), using the name *malvinda* Fruhstorfer (presumably a misspelling of *malvida*), suggested this form was also found in the Republic of Macedonia (formerly Yugoslavia).

Note 49. ***mandarina*** Seitz, 1909: 217: synonym (provisional) of **nominotypical *phoebe***. This very large form (Higgins 1941: 340) occurs in the eastern Palaearctic, considerably further east of the presently known eastern limit of *M. ornata*. Higgins (1941:340) suggested its separation from form *changaica* (see Note 24) was doubtful. Synonymised with *phoebe* by van Oorschot and Coutsis (2014: 60).

Note 50. ***melanina*** Bonaparte, 1831 (125): 159: aberration of ***phoebe occitanica***. This male aberration had the discal ground colour of the underside of the hindwings and the submarginal lunules black. It was taken in July at Subiaco, which is only 400 m above sea level, thus it was almost certainly a specimen from a second brood, ruling out *M. ornata*. Not mentioned by any modern authors.

Note 51. ***minoa*** Fruhstorfer, 1917 (A. 2): 2: synonym of **nominotypical *phoebe***. Higgins (1941: 341) treated this as a small dark race found at high levels, probably identical with nominate *phoebe*; van Oorschot and Coutsis (2014: 61) also placed this with *M. phoebe*. Type material was examined by Bernardi and de Lesse (1951: 141).

Note 52. ***minor*** Wheeler, 1903: 84: an aberration of **nominotypical *phoebe*** based on size, specimens having less than 38 mm wingspan. This was an infra-subspecific name, with no status under The Code, but for the record, the name is preoccupied by *Melitaea arcesia minor* Elwes, 1899 (Higgins 1941: 341). Higgins (1941: 341) suggested, and the present authors concur, that the authority was probably Wheeler as there is no reference given for Frey in Wheeler's book.

Note 53. ***monilata*** Verity, 1919: 184: synonym of **nominotypical *phoebe***. A large, boldly marked and bright alpine form; a specimen of this form from Simplon, Berisal, Switzerland, was figured by Higgins (1941: plate 14, fig. 1); who believed (Higgins 1941: 341) it was related to *ottonis* (Note 61). It is placed with nominotypical *phoebe* due to its TL and similarity to *alternans* (Note 15). Overlooked by van Oorschot and Coutsis (2014).

Note 54. ***monilataeformis*** Verity, 1919: 184: synonym of ***phoebe occitanica***. This name was raised by Verity (1919: 184) for those specimens of *tusca* Verity, 1919 (see Note 96), which displayed *monilata* characters (see Note 53); a TL of peninsular Italy suggests synonymy with *phoebe occitanica*.

Note 55. ***narenta*** Fruhstorfer, 1917 (A. 2): 1, pl. 1, fig. 1: synonym of **nominotypical *phoebe***. Fruhstorfer gave the TL as "Jablanica, Herzegovina", which van Oorschot and Coutsis (2014: 61) wrongly interpreted as Mount Jablanica, which is on the Macedonia (FYROM)/Albania border. Seitz (1909: 207) and Higgins (1941: 341) described this as a large dark race, likening it to *ottonis* (see Note 61). Holotype ♂ inspected by Bernardi and de Lesse (1951: 141). Adults reared from a population of confirmed *M. phoebe* (*i.e.* final instar larvae with black heads and a white lateral stripe) from Serbia were large and dark (Peter Russell pers. obs.); it is likely that such adults are referable to *narenta*. Both sexes of this form were figured by Gaede (in Seitz 1930:

supplement: pl. *Neptis-Argynnis*, figs d: 3, 4) but these were not as dark as reared specimens from Serbia. Synonymised with *phoebe* by van Oorschot and Coutsis (2014: 61).

Note 56. ***nigroalternans*** Verity, 1919: 184: synonym of **nominotypical *phoebe***. An alpine form, which resembles *alternans* (see Note 15) but with a more extensive black pattern (Higgins 1941: 341). Overlooked by van Oorschot and Coutsis (2014).

Note 57. ***nigrogygia*** Verity, 1939: (17): synonym of ***phoebe occitanica***. There has been some confusion related to this taxon. The TL was clearly stated by Verity (1939: (17); 1938: plate III, figs 12 and 14) to be Abbazia, Istria. At that time Istria was part of Italy but after World War 2 it became part of Croatia and the name was changed to Opatija. Higgins (1955: 118) gave the TL as "St. Dionisio, Macedonia at 800 m., gen. 2", mistakenly using data from Verity's *postnarenta* (see Note 68). Tóth and Varga (2010: 274) correctly cited the TL as 'Opatija, Croatia'; but later wrongly as 'Opatija, Macedonia' (Tóth and Varga 2011: 264). Tóth and Varga (2011: 259–260), who did not examine any specimens from Croatia in their published researches on *Melitaea phoebe* species-group genitalia, suggested that 'race' *nigrogygia* was a subspecies of *M. ornata* and not of *M. phoebe*. Van Oorschot and Coutsis (2014: 63) also placed this taxon under '*Melitaea telona*' (*i.e. ornata*) as opposed to *M. phoebe*, accepting the information for the TL given by Higgins (1955: 118) (John Coutsis pers. comm.). Verity (1950: 4 p.152 and Tav. 43: figs 70 and 71) figured the same two ♂♂ he figured in 1938, with the added information: 'captured 15 May' (year not stated) with the original locality data: 'Abbazia, Istria'. A capture date of 15 May does not fit with second generation specimens of *M. phoebe*, as was suggested by Higgins (1955: 118). Russell and Pateman (2013a, b) reared a brood of *M. phoebe* from eggs laid by a female "*nigrogygia*" taken within 20 kilometres of Opatija; the larvae had black heads throughout their lives and most had an orange lateral stripe, clearly associating the taxon *nigrogygia* with *M. phoebe occitanica,* with which it is synonymised here. A study of Verity's actual specimens may provide further enlightenment.

Note 58. ***nimbula*** Higgins, 1941: 337: synonym of ***phoebe occitanica***. Higgins (1941: 337) raised this name for specimens of *occitanica* (see Note 5) with an exaggerated black pattern on the upperside. It was overlooked by van Oorschot and Coutsis (2014).

Note 59. ***ogygia*** Fruhstorfer, 1907: 310: synonym of ***Melitaea ornata***. Recognised as a distinct species by Lafranchis (2007a, b, 2008) but considered a subspecies of *M. ornata* by Tshikolovets (2011), with a distribution of 'S. and C. Greece (including Peleponnese and W. Aegean Is.); probably S.-W. Bulgaria and European Turkey'. *M. ornata* appears to be widespread in Bulgaria (Kolev 2015, pers. comm.). Hesselbarth et al. (1995: 1031–1033) listed over 150 locations for this species (as '*punica telona*'), all of which were in Asian Turkey. So far as the authors are aware *M. ornata* has not been recorded from the Greek region of Thrace, adjacent to European Turkey (Pamperis 2009: 433). The name *ogygia* was placed as a subspecies of *M. ornata* by Tshikolovets (2011: 498), as a synonym of *M. punica telona* (*i.e. ornata*) by Hesselbarth et al. (1995: 1030), and as a synonym of *M. telona* (*i.e. ornata*) by van Oorschot and Coutsis (2014: 63). Russell et al. (2007: 159, figs 16, 17) demonstrated that the larvae had red-brown heads and thus *ogygia* is placed as a synonym of *M. ornata*. The TL was given by Hesselbarth et al. (1995: 1031) as 'Poros, Meerenge von Salamis'; the Straits of Salamis do not exist near Poros Island, nor does it feature on any of the original specimen labels (Russell and Pamperis 2011: 143). Holotype identified by Bernardi and de Lesse (1951: 140).

Note 60. ***ornatiformis*** de Sagarra, 1930: 114: synonym of ***phoebe occitanica***. Type material taken by Querci, 24.viii.1928 at Villacabras, central Spain. Despite its nomenclatural association with *ornata*, geographical source clearly places this with *phoebe occitanica*.

Note 61. ***ottonis*** Fruhstorfer, 1917 (A. 2): 1, nota: synonym of **nominotypical *phoebe*** (a replacement name for *M. phoebe* var. *caucasica* Staudinger 1870 (see Note 22)). Higgins (1941: pl. 14, fig. 1) figured an example of this form from Simplon, Berisal, Switzerland, from which the size and the wing markings clearly suggests synonymy with nominotypical *phoebe*. Tshikolovets (2011: 497) treated this as a subspecies of *M. phoebe*, as did Tshikolovets and Nekrutenko (2012: 293) and Tshikolovets et al. (2014: 318–319). Specimens figured by Hesselbarth et al. (1995 3: Tafel 80/81: figs 30–33 ♂♂; Tafel 82/83: figs 1–4 ♀♀) from eastern Turkey, by Tshikolovets (2003: plate 24: figs 16 ♂ and 17 ♀) from Taberda, Russian Caucasus and by Tshikolovets et al. (2014: plate LX, figs 1–3 ♀♀) from Iran suggest that *ottonis* is best placed as a synonym of nominotypical *phoebe*, as van Oorschot and Coutsis (2014: 61) suggested.

Note 62. ***paedotrophus*** Bergsträsser, 1780: 14, pl. 75, figs 5–6. Synonym of **nominotypical *phoebe***.

Note 63. ***parascotosia*** Collier, 1933: 54: ***Melitaea scotosia***. Name based on a single ♀ specimen taken in July 1923; the author considered this subspecies to be intermediate between *scotosia* Butler and *mandarina* Staudinger. Higgins (1941: 341) considered that the name was "Probably referable to *scotosia*". Lee (1982: 46) placed *scotosia* Butler [TL: Tokyo, Japan] as a subspecies of *M. phoebe.* However, Tuzov et al. (2000: 2: 74), Gorbunov and Kosterin (2007: II: 85) and van Oorschot and Coutsis (2014: 67) synonymised the name with *Melitaea scotosia* Butler, which occurs in the eastern Palaearctic. Although originally described as a subspecies of *M. phoebe*, it does not appear to be associated with any of the three taxa (*phoebe, ornata, punica*) dealt with in this paper.

Note 64. ***parva*** Gerhard, 1882: 126: synonym of **nominotypical *phoebe***. A bright "second generation" form, reared from a larva – colour and host-plant unknown. Higgins (1941) and van Oorschot and Coutsis (2014) overlooked this form.

Note 65. ***parva*** Caradja, 1895: 47: probable synonym of **nominotypical *phoebe***. A small, brightly marked variety of the first generation (Higgins 1941: 341). A larva from Transylvania, Romania, having typical characters (black head with white lateral stripe) of nominotypical *phoebe* was figured by Russell et al. (2007: 159, fig. 14). Székely (2008: 175–176) included reports (unconfirmed by larval head colour) by T. Hácz of *M. punica telona* (= *ornata*) from Transylvania and North-Dobrudja in Romania; however, these records were reported later by Hácz (2012: 73) as *M. phoebe*. Not mentioned by van Oorschot and Coutsis (2014). Since both this and the previous entry are infrasubspecific, they are not covered by The Code.

Note 66. ***pauper*** Verity, 1919:183: synonym of ***phoebe occitanica***. Described as a small, lightly marked form with pale ground colour, the usual summer brood form of *tusca* Verity, 1919 (Higgins 1941: 341 and pl. 14, fig. 3) (see also Note 96).

Note 67. ***phoebina*** Turati, 1919: 222: synonym of ***Melitaea ornata***. A small mountain form (Aspromonte, above 1400 m) rather dark and heavily marked, related to *totila* Stauder, 1914 (Higgins 1941: 341) (see Note 92). According to Turati (1919: 222) there is no second generation of this form, which he considered similar

to that from Ficuzza, Palermo, Sicily (see Note 32). The TL is outside the range of *M. phoebe*, which has not been observed south of Monte Martinellal, Cosenza, Calabria, at the much lower elevation of 880 m (*cf.* discussion on altitudinal separation in Italy in Russell and Pateman 2011: 28) from where 5♂♂ were taken by the first author (identification confirmed from genitalia, club shaped antenna and underside hindwing pattern). Overlooked by other authors, including van Oorschot and Coutsis (2014).

Note 68. ***postnarenta*** Verity, 1939: (17): synonym of **nominotypical *phoebe***. Verity (1939: (17) gave this name to small second generation specimens of *M. phoebe*, resembling *emipauper* (see Note 31). The TL and details of collection for this form were mistakenly attributed by Higgins (1955: 118) to *nigrogygia* (see Note 57). Resemblance to *emipauper* is superficial. Overlooked by van Oorschot and Coutsis (2014).

Note 69. ***postogygia*** Verity, 1939: (16): synonym of **nominotypical *phoebe***. Verity (1939: [16]) gave this name to a small form flying in the hills above Thessalonica in August; close association with the name *ogygia* (*i.e. M. ornata* – see Note 64) is misleading. Higgins (1955: 118) included the name in his list of synonyms of *M. phoebe* and indicated a similarity with *parva* (see Notes 64 and 65) and *pauper* (see Note 66). A second generation form (*M. ornata* is single-brooded – see Note 2) from central Greece places this taxon with nominotypical *phoebe*. It was overlooked by van Oorschot and Coutsis (2014).

Note 70. ***postvirgilia*** Verity, 1950: 154: synonym of **nominotypical *phoebe***. The second generation of the Alpine first generation form *virgilia* (see Note 100). Not listed by Higgins (1941, 1955) or any recent authors.

Note 71. ***pseudosibina*** Alberti, 1969: 192, Taf. 1, figs 1c and 2c.: synonym of **nominotypical *phoebe***. Synonymised with nominotypical *phoebe* by Hesselbarth et al. (1995: 1028), and with "*M. phoebe*" by van Oorschot and Coutsis (2014: 61). Judging from the paratypes figured by Alberti (1969: Taf. 1, figs 1c and 2c) and the specimen figured by van Oorschot and Coutsis (2014: plate 12, fig. 24), which has clubbed antenna and hindwing underside arcuate submarginal markings reaching the intervening veins, this is correct. Tshikolovets (2011: 497) placed it as a synonym of *Melitaea phoebe ottonis* (see Note 61), as did Tschikolovets and Nekrutenko (2012: 293).

Note 72. ***punicapowelli*** Oberthür, 1915: fig. 2338: synonym of ***Melitaea punica***. Specimens of *M. punica* which have the black pattern partly obsolete (Higgins 1941: 342).

Note 73. ***punicata*** Ragusa, 1919: 150: synonym of ***Melitaea ornata***. Equated to *emipunica* (see Note 32) by Higgins (1941: 342).

Note 74. ***reliquiae*** Korb et al., 2015: 143 and plate VI: synonym of ***Melitaea ornata***. Information on the populations in the Volgograd region was first published by Kuznetsov and Stradomsky (2010) under the name *Melitaea telona* and later by Russell and Kuznetsov (2012) under the name *M. ornata*.

Note 75. ***rostagnoi*** Turati, 1920: 223: synonym of ***phoebe occitanica***. A small second generation form, probably much the same as *emipauper* Verity (see Note 31) and *autumnalis* Fruhstorfer (see Note 17) (Higgins 1941: 342). Synonymised with *M. phoebe* by van Oorschot and Coutsis (2014: 61).

Note 76. ***rovia*** Fruhstorfer, 1919: 169: synonym of **nominotypical *phoebe***. According to Higgins (1941: 342) this is a low elevation form with reduced black markings. A holotype and allotype were examined by Bernardi and de Lesse (1951: 141). Synonymised with *M. phoebe* by van Oorschot and Coutsis (2014: 61).

Note 77. ***rubialesi*** Gómez Bustillo, 1973: 36: form of ***Melitaea phoebe occitanica***.

Note 78. ***rubrofasciata*** Gušić, 1922: 95: probably a synonym of **nominotypical *phoebe***: Higgins (1941: 342) Noted this as a small form with a deficiency of black pattern on the discal area of the wings. However, the name seems to indicate the presence of some red colour on the wings. Although Koren and Štih (2013) recorded *M. ornata* from five localities in Croatia, one of which was near Zagreb, the identity of the species has been questioned (Koren pers. comm.) The first author visited two of the locations concerned in May 2015 and considered that the biotope was unsuited to *M. ornata*. Podsused (the TL) is on the banks of the River Sava at *c*. 125 m above sea level and appeared on recent inspection to be encompassed by industrial buildings (Russell pers. obs.); it would seem unlikely that either species would be extant currently in that locality.

Note 79. ***sarvistana*** Wiltshire, 1941: 473, fig. 3: ***Melitaea sarvistana***. Originally described as a race of *M. phoebe* based on two male specimens; a large form, with black submarginal lunules complete on both wings, other markings faint with nearly obsolete discal markings; on the underside of hindwings the black markings are prominent (Wiltshire 1941). Wiltshire (1946: 25, plate 1: figs 1 and 2)), from an examination of the genitalia, elevated this to species status. Higgins (1955: 117, pl. I, fig. 17 pl. II, fig. 17) also considered it a distinct species. Eckweiler and Hofman (1980: 10), Racheli (1980: 80–81), Koçak et al. (1997: 4), Nazari (2003), Kolesnichenko (2007: 30), van Oorschot and Coutsis (2014: 69 and pl. 14, figs 20–22) and Tshikolovets et al. (2014: 321 and pl. LX, figs 13–15, 18) all followed Wiltshire in recognising *sarvistana* as a distinct species. The present authors have no personal experience of this taxon but it appears to be different from any examples of the taxa under consideration; its inclusion here is only because it was originally described in association with *M. phoebe*.

Note 80. ***saturata*** Staudinger, 1892: 323: synonym of **nominotypical *phoebe***. A large brightly coloured form resembling many mountain forms of *phoebe* (Higgins 1941: 342). It occurs in the eastern Palaearctic and, since the presently known eastern limit of the distribution of *M. ornata* is Kazakhstan, southeast of the Ural Mountains, placement with nominotypical *phoebe* seems appropriate. Synonymised with *M. phoebe* by van Oorschot and Coutsis (2014: 60). Korb (2011: 158) identified *Melitaea* specimens from N Tian-Shan as *M. phoebe saturata*. The TL of *saturata* is Mongolia, some 2500 km northeast from Tian-Shan. Korb et al. (2015: 142–143, Col. pl. VI, figs 3 and 4), who then considered that *M. phoebe* was absent from Tian-Shan, reassessed this population as *M. ornata*; we consider *saturata* a synonym of *M. phoebe phoebe*.

Note 81. ***seminigra*** Delahaye, 1909: 10: aberration of ***phoebe occitanica***. This aberrant female specimen, with almost black forewing uppersides, was taken in June at Pignerolles, Maine et Loire in west central France and thus outside the ranges of both nominotypical *phoebe* and *M. ornata*. Higgins (1941: 342) stated that he did not view the original publication and thus could make no comment on this name. It has not been mentioned by any recent author.

Note 82. ***sextilis*** Jachontov, 1909: 285: synonym of **nominotypical *phoebe***. A small second generation form of *caucasica* (see Notes 22, 61) taken in the southern Caucasus in August. Higgins (1941: 342) and van Oorschot and Coutsis (2014: 60) placed this with *M. phoebe*.

Note 83. ***sibina*** Alphéraky, 1881: 400, Tabl. XIV fig.13: **status unclear** (distinct species/synonym of **nominotypical *phoebe***). This taxon is distributed mainly outside the western Palaearctic, with a western distribution limit in the Republic of Kazakhstan (Tshikolovets 2003: 328). Originally described as a variety of *M.*

phoebe, it was given species status by Higgins (1941: 349, plate 15: figs 5, 6, 11 and 12) and this has been followed by some recent authors (for example: Tshikolovets 2003: 328–329, 2005: 338; van Oorschot and Coutsis 2014: 65–66). It does not appear to be directly associated with any of the three taxa dealt with in this paper. We note that Tóth and Varga (2011) and Tóth et al. (2014) were unable to separate it from *M. phoebe* using molecular or morphometric procedures.

Note 84. ***sterlineata*** Turati, 1920: 223, Tav. II, figs 10–12: synonym of ***phoebe occitanica***. Although placed by Turati as an aberration of *phoebina* (= *ornata*, see Note 64), the specimens were taken by GC Krüger, at 800 m altitude, in September 1909; it must therefore represent a second or even third generation form, which precludes it from being *ornata*, which is univoltine.

Note 85. ***streltzovi*** Kolesnichenko & Yakovlev, 2004: 103: synonym of **nominotypical *phoebe***. Distributed along the south-western slopes of the Mongolian Altai. All specimens taken in the first part of July, flying in mesophilous grasslands and river valleys. The figures (Kolesnichenko and Yakovlev 2004: figs 10, 11 on plates V and VI) show both sexes are heavily marked with a pale background on the upper surfaces of both fore- and hindwings. The club shaped antenna and the arcuate submarginal markings appearing to reach the intervening veins (see Table 1), suggest association with *M. phoebe* rather than *M. ornata*. Synonymised with *M. phoebe* using van Oorschot and Coutsis (2014: 61)

Note 86. ***subcorythallia*** Verity, 1928: 162: synonym of ***phoebe occitanica***. "The second generation of France" (Higgins 1941: 342).

Note 87. ***suboccitanica*** Verity, 1928: 162: synonym of ***phoebe occitanica***. "The first generation of France" (Higgins 1941: 342).

Note 88. ***subtusca*** Verity, 1952: 349: synonym of ***phoebe occitanica***. Verity (1952: 349) referred this form from southeast France to *tusca* from central Italy (see Note 96), and it is placed with *phoebe* o*ccitanica* as a result. *M. ornata* from Var, France occurs in a very different phenotype from the form of *phoebe occitanica* occurring in central Italy (Verity 1951: plate 44, figs 1–16), the former being much darker in colour and having triangular submarginal lunules (Russell et al. 2007: 162 fig. 52). Overlooked by van Oorschot and Coutsis (2014).

Note 89. ***sylleion*** Fruhstorfer, 1917 (A. 2): 2: synonym of **nominotypical *phoebe***. Higgins (1941: 342) considered this form to be inconsistent. The holotype and allotype were inspected by Bernardi and de Lesse (1951: 141). It was placed by van Oorschot and Coutsis (2014: 61) as a synonym of *M. phoebe*.

Note 90. ***tatara*** Krulikovsky, 1891: 236: **status uncertain** (possibly a hybrid). Spelt *tartara* (sic) by Higgins (1941: 342) but subsequently corrected (Higgins 1944: 46). The origin of this name refers to Tatastan, a Russian Province in which Casan, the TL, is located. Although Krulikovsky placed it under *M. phoebe*, *M. ornata* was not at that time established as a species. Higgins (1941: 342) said: 'An example in which there is a double black line across both wings parallel to the outer margin' but this is not helpful to place it with either species. Krulikovsky's figure (1890: 236, VIII, fig. g) does not allow identification; in fact Krulikovsky himself suspected that it was a hybrid between *M. phoebe* and *M. athalia*. Having later observed a ♂ *M. phoebe* coupling with a ♀ *M. arduinna* (Esper, [1783]), Krulikovsky (1897: 321), restated his suspicion that *tatara* was a

hybrid. It is noted that hybrids have been recorded between *M. ornata* and *M. phoebe* by Bálint and Ilonczai (2001: 217) in Hungary and by Russell et al. (2014: 140, figs 7–9) in Slovenia; since both species probably occur in this area to the west of the Urals in the Russian Federation, a hybrid origin remains a possibility.

Note 91. ***telona*** Fruhstorfer, 1907: 310: synonym of ***Melitaea ornata*** (but see below). The holotype and allotype were examined by Bernardi and de Lesse (1951: 140). This name was placed as a subspecies of *M. ornata* by Tshikolovets (2011: 499) and by Tshikolovets and Nekrutenko (2012: 295). This is the name used by a number of authors for what is now known to be *M. ornata*, including the first author (Russell 2008; Russell and Pateman 2011), prior to our present understanding of the range of *M. ornata*, which led to the recognition that *ornata* and *telona* were conspecific. Russell et al. (2007: 159, fig. 15) demonstrated that the larva of *telona* from its TL has a red-brown head; larvae of *ornata* from Volgograd region, Russia, are similarly coloured and also has a red-brown head (Russell and Kuznetsov 2012: figs 1–3), suggesting synonymy with *M. ornata*. However, recent molecular analysis by Tóth et al. (2014) apparently suggests that *telona* may represent a species distinct from *ornata*; only two samples of *telona* from Lebanon, the origin of the 'voucher specimen' used as an example of *telona* by Wahlberg and Zimmermann (2000) for their mtDNA sequencing, were included in their analysis. Until this is resolved, it is considered prudent to retain *telona* as a synonym of *M. ornata*. Rather confusingly, van Oorschot and Coutsis (2014: 63) considered *telona* a distinct species and placed *ornata* as a synonym of *M. phoebe*.

Note 92. ***totila*** Stauder, 1914: 373: synonym (provisional) of ***Melitaea ornata***. The first author visited Monte Cocuzzo, the TL, on a number of occasions but, in spite of the presence of a known host-plant (*Centaurea deusta* Ten.: Russell and Pateman 2011) only discovered one worn ♀ at *ca.* 1200 m, which unfortunately died prior to ovipositing. It appeared from its hindwing markings and spatulate antenna to be *M. ornata*. Also, a single ♂ was taken on Monte Mancuso, Calabria, some 24 km to the south, which from an examination of genitalia and external morphology, was almost certainly *M. ornata*. This form is therefore provisionally placed with *M. ornata*.

Note 93. ***tremulae*** Piller & Mitterpacher, 1783: 69, Taf. 4: figs 1 and 2: synonym (provisional) of **nominotypical *phoebe***. The TL of Croatia, from where there have been no substantiated reports of *M. ornata*, strongly suggests association with *phoebe phoebe*. Hesselbarth et al. (1995: 1028) synonymised this name with *M. phoebe phoebe*. Not mentioned by any more recent authors.

Note 94. ***tungana*** Seitz, 1909: 216: synonym (provisional) of **nominotypical *phoebe***. The specimens were described by Seitz (1909: 216) as very melanic but the specimens examined by Higgins (1941: 342) showed that this character was variable in the Sayan Mountains (the TL) and suggested that many of these specimens were close to *monilata* Verity (see Note 53) and other Alpine forms (see Higgins 1941: 334). The form *tungana* has a distribution in the eastern Palaearctic and outside the presently recorded distribution of *M. ornata*, the authors provisionally place *tungana* with *M. phoebe*. Overlooked by van Oorschot and Coutsis (2014).

Note 95. ***tungusa*** Herz, 1899: 240: synonym (provisional) of **nominotypical *phoebe***. A small form with obscure markings, in appearance somewhere between var. *caucasica* Staudinger (see Note 22) and *M. ornata* (see Note 2). Synonymised with *M. phoebe* by van Oorschot and Coutsis (2014: 60). Since it occurs in the eastern Palaearctic, it is synonymised with nominotypical *phoebe* until further information becomes available.

Note 96. ***tusca*** Verity, 1919: 183: synonym of ***phoebe occitanica***. Described by Verity (1909: 183) as a form with bright orange upperside ground colour and reduced black markings. Higgins (1941: 342) considered this to be a first (spring) brood form from central Italy, and was of the opinion that the names *emipauper* Verity, 1919, *pauper* Verity, 1919 and probably *autumnalis* Fruhstorfer, 1919 referred to the second or third (summer) broods of *tusca* (see Notes 31, 65 and 17, respectively). Placed here as a synonym of *phoebe occitanica* largely due to its geographical location in peninsular Italy. This name was overlooked by van Oorschot and Coutsis (2014).

Note 97. ***uclensis*** Melcón, 1910: 219: aberration of ***phoebe occitanica***. Described as an aberration of *occitanica* with the upperside black marginal semi-lunules separated from the black marginal line by red ground colour. Its origin in central Spain clearly places it with *occitanica*. Overlooked by van Oorschot and Coutsis (2014).

Note 98. ***ufensis*** Krulikovsky, 1902: 555 (footnote): synonym of ***Melitaea ornata***. A replacement name for *uralensis* Krulikovsky, 1897 (see Note 99); van Oorschot and Coutsis (2014: 60) incorrectly placed this as a synonym of *M. phoebe*.

Note 99. ***uralensis*** Krulikovsky, 1897: 3: name preoccupied by *Melitaea arduinna uralensis* Eversmann, 1844. Replaced with *ufensis* by Krulikovsky (1902: 555 footnote). Van Oorschot and Coutsis (2014: 60) incorrectly placed this as a synonym of *M. phoebe* (see Note 98).

Note 100. ***virgilia*** Fruhstorfer, 1917 (A. 2): 2: synonym of **nominotypical *phoebe***. Higgins (1941: 343) treated this as a large race with pale ground colour and black markings reduced, although he recognised that these features were not constant. The relatively larger than average size and its TL in the French Alps places this taxon with nominate *phoebe*, with which it was placed by van Oorschot and Coutsis (2014: 61). Holotype and 5 ♀♀ paratypes were examined by Bernardi and de Lesse (1951: 141).

Note 101. ***wagneri*** Wnukowsky, 1929: 222: replacement name for *alatauica* Wagner, 1913 (see Note 11).

Note 102 ***yagii*** Nire, 1917: 146, including fig. 2: ***Melitaea scotosia***.This taxon is confined to the eastern Palaearctic. The name *yagei* (sic) was synonymized with *M. scotosia* Butler, 1878 by Higgins (1941: 343). This synonymy and misspelling were followed by van Oorschot and Coutsis (2014: 67). Although originally placed with *M. phoebe*, it does not appear to be associated with any of the three taxa (*phoebe*, *ornata*, *punica*) dealt with in this paper.

Note 103. ***zagrosi*** Tóth & Varga, 2011: 265: synonym (provisional) of ***Melitaea ornata***. This name was raised as a distinct species based on male and female genitalia and underside wing markings. However, it would appear from Tshikolovets et al. (2014: 320, map) that the type locality of this form is within the distributional area of *abbas*, which they elevated to a subspecies of *Melitaea ornata*. Van Oorschot and Coutsis (2014: 64) discussed the status of *zagrosi* at some length, referring to the unreliability of wing markings, which has been demonstrated in *Melitaea* taxa by Jugovic and Koren (2014), and genitalia preparations when placed in covered slides creating distortion. They concluded that there was insufficient evidence to support the erection of a new taxon and classed it as '*status incertus*'. Tshikolovets et al. (2014: 320) synonymised it with *M. ornata abbas* (*i.e. ornata*) (see Note 7). The elevations at which these two forms occur (*zagrosi*, 300 m; *abbas*, 1500–2500 m) may be significant. Until additional evidence becomes available, it is provisionally placed with *M. ornata*.

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In Memoriam: Marc Meyer (1954–2015)

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Figure 1. Marc Meyer 2006 (photo: C. Harbusch).

Marc Theo Jean Meyer was born on November 29, 1954 in Luxembourg, and he died on February 28, 2015 in Merzig, Saarland, much too early, at the age of only 60 years. Nevertheless, he has left a remarkable legacy with almost 100 scientific publications and extensive entomological collections, as shall be pointed out in this obituary.

After attending primary and secondary schools in Luxembourg he received his high school diploma in 1974 and began his studies in biology and geography at the University of the Saarland. He was one of those exceptional students who was not motivated by the syllabuses of the subjects taught to him, as he had already acquired much of the knowledge involved. Even as a schoolboy he had published scientific contributions in "Entomologische Zeitschrift" and "Bulletin de la Société des Naturalistes Luxembourgeois" (1972, 1973). It is mentioned there that it was his father Jean Meyer who inspired his love of nature and who accompanied him on almost all of his early entomological excursions. Already as a pupil he had founded an entomological working group "Jeunesse Naturaliste du Luxembourg" in 1972, and he was twice prize-winner of the contest "Jugend forscht".

In his studies, apart from entomology, he was most interested in lectures on zoogeography. During excursions to France (Champagne and Provence) in 1976 and to the Pyrenees in 1979 he had to record the observed and collected Lepidoptera (Fig. 2). Figure 3 shows him reporting about Lepidoptera to members of the natural history societies Delattinia of the Saarland and to those of Luxembourg at the nature reserve Hammelsberg near Perl in 1981.

He finished his studies by taking the state examination for teaching in high schools in 1979. The topic of his treatise "Systematic and chorological investigations of the Rhopalocera-fauna of São

Figure 2. Marc as a student on a biogeographical excursion in 1976 (photo: H. Schreiber).

Sebastião", a south-Brazilian coastal island, was chosen by his supervisor Prof. Paul Müller, who had visited the island for herpetological studies in 1964, 1965, and 1967. Lepidoptera, collected by him for Prof. de Lattin, had not previously been evaluated. Marc Meyer had to prepare the material as a first step. He then identified the specimens very carefully as can be seen by the fact that he consulted well-known specialists of South American Lepidoptera (Keith Brown, Olaf Mielke, and Heinz Ebert) in cases where he was not certain. Altogether, 95 butterflies from the island of 335 square km were treated in detail with respect to their differences from the mainland populations.

At the same time the treatise laid the foundation for his lifelong interest in the biogeography of islands. In excursions to Madeira, to the Azores, and the Canaries and in publications (1991, 1993, 1995, 1997), with co-authors (1990, 1997, 1998), he later on became concerned with the Lepidoptera of the Macaronesian isles and collected extensive material from there. It was his intention to write a thesis in that field. However, the chances to do so were not only much limited by his professional duties but also by his obvious honourable awareness that he had not studied for a doctorate.

After the probationary period at the technical lyceums Michel-Lucius in Luxembourg and Mathias Adams in Pétange in 1981, he obtained and held the position of Curator for Entomology at the Museum for Natural History in Luxembourg until his retirement owing to illness after 28 years of service in 2013. Building reconstruction was carried out where his office had been during the time of his employment and a new building of the Museum was opened in 1996. Little space, however, existed for the collections in his charge in a compact installation within the museum itself. A larger part is out-housed to a warehouse in Kehlen near Capellen in SW Luxembourg and which had to be visited by him in his work. It was his main task to register the fauna of Luxembourg, especially the Lepidoptera. His work is documented by regular publications mainly from the working group for invertebrate research (1981, 1983, 1985, 1986, 1987, 1988, 1989, 1990, 1991, 1992, 1993), partly together with co-authors (1979, 1984) – see below. His commitment in mapping European invertebrates can be seen from the publication "Atlas Provisoire des Insects du Grand-Duché de Luxembourg", published together with A. Pelles in 1981.

Being multilingual, Marc was the ideal person for the position of the General Secretary of the "European Invertebrate Survey" (EIS), a position he held for 12 years. The task made it necessary for him to travel regularly to other countries, e.g. to the European Parliament in Strasbourg. It involved

Figure 3. Marc demonstrating Lepidoptera at the nature reserve Hammelsberg near Perl in 1981 (photo: H. Schreiber).

furthermore the organization of congresses. He founded a cross-border working group of experts for Lepidoptera in 2001 and organized several "days of entomology of the Sar-Lor-Lux-Region".

He was a member of relevant professional societies such as SNL in Luxembourg and was responsible for the compilation of "Paiperlék" for many years. He was a member of the natural history society "Delattinia" of the Saarland, the "Société Entomologique" of Mulhouse and subscriber of "Oreina (Les Papillons du France)"; he was member of "SHILAP" in Spain and of "Societas Europaea Lepidopterologica" (SEL). He hosted the SEL Congress in Luxembourg together with the team of the Invertebrate section of the museum in 2011.

Marc was awarded the orders of "officier de l'ordre de mérite" and "officier de l'ordre Grand Ducal de la Couronne de Chéne" for his scientific work and his manifold engagement in organization by the State of Luxembourg.

Of his publications the revision of the European populations of *Lycaena helle* (1981–1982) has first to be mentioned. *Lycaena helle* (violet copper) is a glacial relict with many peculiarities. He had published repeatedly on this species (1980) and reported about it at the SEL Congress in Cambridge in 1982 (1985).

It is of great merit that with his co-editors Jan Habel and Thomas Schmitt a volume of 235 pages concerning this extremely endangered species was published by 2014. Nineteen contributions of authors from all of Europe deal with biogeography, ecology, and questions of conservation. The volume was published in English by Pensoft in Sofia (2014). It bears the title "Jewels in the Mist" since the violet copper can be found on wet meadows with *Polygonum bistorta*, which are certainly often enveloped in mist. It is amazing how he even found the time for any private life given the huge number of excursions to countries like Morocco, Australia, Ecuador, and Costa Rica in addition to the islands of Macaronesia. The voucher material collected from the Sar-Lor-Lux-region is stored in the Museum of Natural History in Luxembourg while exotic material and such from Macaronesia collected on private excursions has been transferred to "Delattinia" for further studies.

Marc married Dr. Christine Harbusch in 1999. They had become acquainted at the Natural History Museum of Luxembourg. They renovated and moved into a farmhouse in Perl-Kesslingen and shared it with several larger and smaller animals in the course of time. Marc accepted with tolerance his home turning more and more into a sort of charity hostel for animals without realizing that he himself would one day become an invalid because of illness.

We were able to celebrate with him his retirement from office in February 2013 and his 60th birthday, when he was already in a nursing home in Beckingen, in November 2014.

We feel grateful for his legacy and will keep Marc in great honour.

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Alucitidae (Lepidoptera), a new family for the Mongolian fauna

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Abstract. Lepidoptera family Alucitidae is reported for the first time for the fauna of Mongolia. *Alucita helena* Ustjuzhanin, 1993 was discovered in West Mongolia in the ranges of the Dzun-Dzhargalant-Khairkhan.

Introduction

The Lepidoptera fauna of Mongolia in general, and that of the Mongolian Altai in particular, is still poorly known. There are relatively detailed records available for the Papilionoidea (Tshikolovets et al. 2009; Yakovlev 2012), Sphingidae (Derzhavets 1977; Yakovlev et al. 2015), Zygaenidae (Efetov et al. 2012), Cossidae (Yakovlev 2004, 2015), Notodontidae (Schintlmeister 2008), *Eupithecia* (Geometridae) (Mironov and Galsworthy 2014), and Pterophoridae (Ustjuzhanin and Kovtunovich 2008). There were no detailed records for other lepidopteran taxa currently available.

Much new information was obtained on the distribution and systematics of Lepidoptera of Mongolia during expeditions by entomologists and botanists from the Altai State University (Barnaul, Russia) starting in 1999. These studies were concentrated in the territory of West Mongolia, primarily in the Mongolian Altai Mountains (aimaks Bayan-Ulegei, Khovd and Gobi-Altai). During the expedition of 2015 in the ranges of Dzun-Dzhargalant-Khairkhan, a large series of *Alucita helena* Ustjuzhanin, 1993 of the family Alucitidae (Lepidoptera) was collected. This species is a new family record for Mongolia. The "many-plumed moths" of the world include 216 species (van Nieukerken et al. 2011).

Material and methods

Adult Alucitidae were collected using a combination of a Philips–250 W lamp mounted above a fabric screen and battery-powered light traps using TL 8W/05 lamps. Chloroform was used as a killing agent. The collected material is deposited in the private collection of the first and second authors.

Results

Alucita helena Ustjuzhanin, 1993

Figs 1–5

Alucita helena Ustjuzhanin, 1993: 83. Type locality: Russia, Altai Republic, Ongudai District, village of Inya.

Material examined. 112 ex. from Western Mongolia, Khovd Aimak, Dzun-Dzhargalant-Khairkhan, Ar-Shatyn-Gol River, N47º44' / E92º27', 2100 m, 26.vi.2015., leg. R. Yakovlev.

Notes. In addition to the type locality, specimens of *A. helena* were examined from the Republic of Altai (Ongudai District, near B. Yaloman village; Kosh-Agach District, 15 km up from Beltir village, Chagan River; Kosh-Agach District, 15 km E Kokorya; Ust-Kan District, Shiverta River Valley, 5 km SW of Beshozek village; Ulagan District, 10 km NW of Aktash village, Chuya road) (Fig. 4). Probably larvae of this species are associated with *Lonicera* (Caprifoliaceae) (Zagulajev 1986). There are two generations with adults of the first flying in June and those of the second in August. The adults of the second generation are larger and darker than those of the first.

Figure 1. *Alucita helena* Ustjuzhanin, 1993. Adult male, Mongolia.

Figure 2. Male genitalia of *Alucita helena*.

Figure 3. Female genitalia of *Alucita helena*.

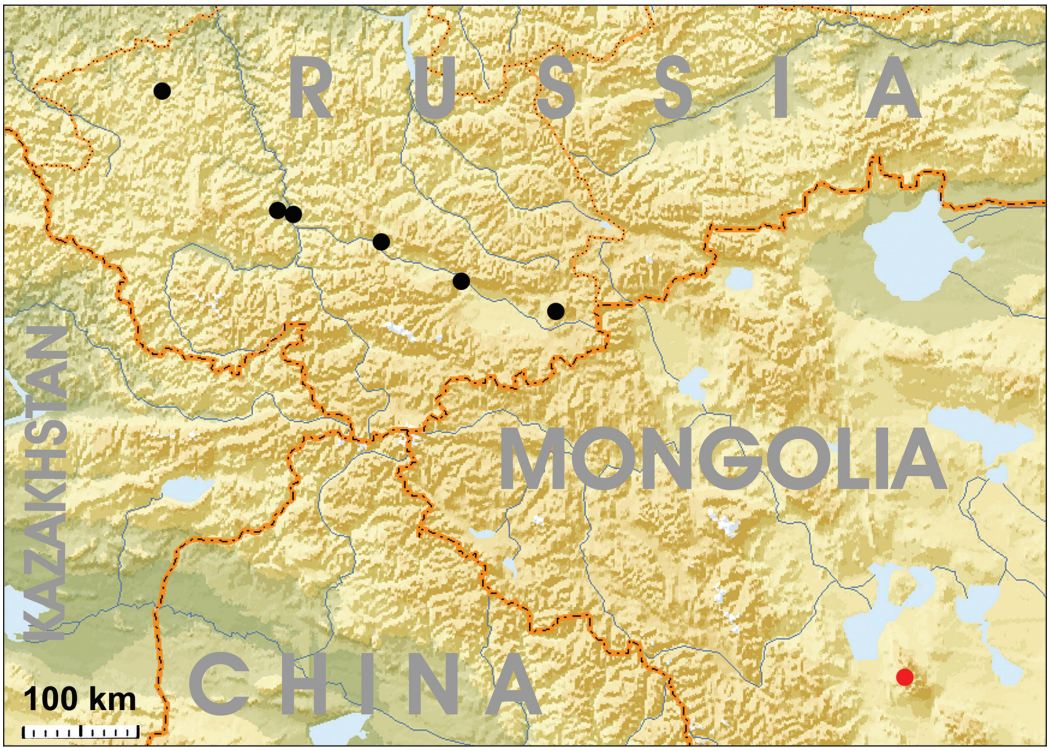

Figure 4. Distribution of *Alucita helena*.

Figure 5. Biotope at collecting locality of *Alucita helena* in Mongolia.

Specimens were collected in Mongolia at Khar Us Nuur National Park, Dzhargalant-Khairkhan Ridge (Fig. 5). The 850 000 ha park is located 45 km southeast of the center of Khovd Aimak. In the central portion of the park there are lakes Khar Us, Khar, and Durgun. The park includes the Chono Kharaih River and the eastern spurs of Dzhargalant-Khairkhan.

According to the new botanical-geographical zonation scheme for Mongolia (Kamelin 2010), the Dzhargalant-Khairkhan Ridge is located in the boreal region, steppe subregion of the Tuva-Mongolian Province, Khovd District. The eastern macroslope of the ridge borders the Lacustrine-Basin District and in the South the Shargyn Gobi exclave of the Gobi Subregion. The predominant type of the ridge vegetation is steppe with dry and desert areas reaching 3000 m.a.s.l. The extent of desert plant species in this steppe is not great, in contrast to the Shargyn Gobi exclave steppe where they predominate. In the foothills and middle mountains of Dzhargalant-Khairkhan, the desert steppe is widespread. Steppe plants occupy plains and slopes of the mountains at the altitudes of 1700 (2100)−2250 (2300) m.a.s.l. (Karamysheva et al. 1984). A petrophyte vegetation has developed on the steep slopes of the ridge while a vegetation of rocky substrates occurs on the ravine bottoms and in valleys (Pyak 2006). Poplar forests of *Populus laurifolia* Ledeb. (Salicaceae) and the shrub *Lonicera microphylla* Willd. Ex. Schult. (Caprifoliaceae) grow on rocky substrates along the river valleys. *Salix ledebouriana* Trautv. (Salicaceae) and *Rhodiola krylovii* A.V. Polozii & N.V. Revyakina (Crassulaceae) occur in narrow gorges. The highland ridge belt is occupied by the kobresia and kobresia-sedge alpine heathlands and the cryophilic meadow-steppe where *Papaver pseudotenellum* Grubov (Papaveraceae), *Pulsatilla bungeana* C. A. Mey ex. Ledeb. (Ranunculaceae) and *Pedicularis achilleifolia* Stephan ex. Willd. (Orobanchaceae) occur. During the field work in the National Park over 100 Lepidoptera species were collected. The material is being studied and results will be published later.

Conclusion

The composition of the Lepidoptera fauna of the Mongolian Altai appears rich and the discovery of a new family in this region clearly indicates that other interesting taxa will be discovered. Also of interest is the relative disjunction of the Mongolian population of *A. helena* from other known localities for the species (Fig. 4).

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In Memoriam: Pamela Gilbert (1932–2015)

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Pam Gilbert pictured in the Reading Room of the General Library, Natural History Museum, May 2008 – the "gentle smile … sparkling eyes and … challenging look" still very much in evidence. Tools of the trade include a large lens, and one of those seemingly unique NHM tear-off paper 'book-boards'. [Photograph: Lorraine Portch]

Best wishes for the future. You deserve it for all you have put into life.
Eric Classey, on the occasion of Pam Gilbert's retirement, 1992

Early years

Pamela Gilbert was born at Queen Charlotte's Maternity Hospital, Hammersmith, London, on 14th December 1932, the daughter of Albert Edward Gilbert and Ellen Isabella Gilbert (née Clark). At this time the family were living at 121 Cromwell Road SW7 – only a few hundred metres west of the Natural History Museum, where she later spent all her working life. Today 121 Cromwell Rd looks an imposing address, given that her father is described on the birth certificate as a "general labourer". Pam later recalled her father as a taxi driver; her mother, who died at a relatively young age, had employment as a cook and housekeeper.

By the outbreak of WWII the family were living in the Ladbroke Grove area, near Paddington railway station. They survived the blitz of 1940 but, with the continuing bombing raids, like so many other London children, the following year Pam was 'evacuated' – in her case to Nailsworth, Gloucestershire, a country town about 40 km NE of Bristol. Many evacuees endured a miserable existence, away from family and friends, but Pam remembered this as a happy time – she was placed in the care of a kind family, other children from her part of London were around, she attended a good junior school, and it was her first experience of country living. But by 1944 there was concern regarding her secondary education and she was moved, with many other evacuees, to a special school in the Oxford area.

By the end of the war Pam had rejoined her family, who had moved at some point to the Bounds Green area of North London. Pam completed her secondary education at Trinity County Grammar School, Wood Green, gaining School Certificate qualifications in English (Language and Literature), French, Mathematics, Biology, History, Geography, Shorthand and Typewriting, passing with distinction in French, Biology and Geography, and then gained, at Higher Level, a qualification in Botany.

From part of a photograph available on the Trinity Old Scholars Association website (http://tosa.homestead.com/19496thFormL.html) showing the Trinity School 6th form for 1949–50. Pam, not identified on the website legend, is centre, sitting to the left of a girl identified as Miss Yvette Borrell, and to the right of an unidentified fellow pupil. [Photograph: TOSA, permission applied for]

Entomology at the Natural History Museum

Noting her aptitude for biology, a school careers adviser suggested she try for a post at the Natural History Museum in South Kensington. Apparently, Pam had never heard of the place! But thus encouraged, she applied to become an "Assistant (Scientific)" at what was then officially known as the British Museum (Natural History). So it came to pass that on 1st October 1951, eleven weeks before her 19th birthday, Pam Gilbert started work in the Setting Room – a service unit for the Museum's Department of Entomology that also acted as a training section for new assistants. The Setting Room at that time was managed by S.J. ('Dick') Turpin, also responsible for discipline(!) amongst the junior staff. Duties included learning how to prepare specimens for the collections, slide making, printing labels, looking after and administering departmental stores, packing parcels of insects for the post, and 'Saturday Duty' – a rota requiring two assistants each Saturday to run the Entomology Department enquiry desk, and deliver internal mail throughout the museum as a whole.

New staff spent months, sometimes years in the Setting Room before, typically, being allocated to one of the several taxon-based sections into which the department was divided. In 1954 Pam was assigned to the Diptera Section which, at that time, notably included Paul Freeman, Harold Oldroyd, Peter Mattingly and Ralph Coe but, for various reasons, she was not very happy there. In the following year she was offered the chance of a transfer to one of the Museum's earth science libraries, but declined due to her lack of relevant background. But Pam's direct association with the dipterists was anyway short-lived, as she successfully transferred to the Entomology Library in 1956 "at her own request" (Freeman, memorandum, 9th June 1969). At that time the departmental libraries of the Museum were still under the direct control of the Keepers, the heads of the scientific departments – the Keeper of Entomology in 1956 being W.E. China, successor to the long-serving N.D. Riley.

The Entomology Library

The Department of Entomology (1913–2012) did not take responsibility for the purchase and control of purely entomological publications and library material until 1937. By this time Clarence ('Charlie') Wood was in charge of the Entomology Library, with Bernard Clifton a part-time attendant. At the outbreak of WWII the library was dispersed to How Caple Court, near Ross-on-Wye, and Wray Castle, Ambleside.

In 1946 Bernard Clifton returned from war service and, due to Wood's ill health, gradually took over, by 1949 effectively becoming the Entomology librarian. In February 1952, on final completion of the long delayed Entomology Building (only about half of it had been completed before WWII), the main part of the insect library was relocated on the third floor. Pam Gilbert was appointed Assistant Librarian on 1st October 1956, as the second member of staff, replacing Wood on his retirement.

At the time of her first employment at the Museum, Pam was still living near Bounds Green, but she later moved to the Paddington area, and thus much closer to her work. To become better fitted for her new role, Pam took the First Professional Examination of the Library Association (now 'CILIP'), and then attended their course for Associate status – but did not sit the ALA exam because of a change to full-time attendance as a requirement. Her LA studies were carried out, at least in part, at the North Western Polytechnic in Kentish Town – historically, part of what is now London Metropolitan University. In addition to French, Pam had some German, Russian and Turkish.

In 1974, on Clifton's retirement, Pam became the entomology Librarian. By this time she had been promoted, first to the rank of Senior Scientific Assistant (1960), then Experimental Officer (1st December 1970). Pam remained as head of the Entomology Library until 1991, when she became full-time Deputy Head of the Museum's Department of Library Services, with the grade of Principal Scientific Officer.

By the late 1960s the Entomology Library, which occupied about a quarter of a floor of the Entomology building, was almost literally bursting at the seams. Fortunately there was a plan. By 1972 the Museum's new ornithology building at Tring had been completed, and the very substantial NHM bird collection which at that time occupied much of the three lower floors of Entomology was relocated. In return, up from Tring came the Rothschild Lepidoptera and various other insect collections – but there was still a net gain of space at South Kensington. The adjacent Diptera collections and staff were moved from the 3rd to the 1st floor, allowing the library literally to double in extent. Into this space were packed dozens of new book cases.

So close to his own retirement, Bernard Clifton showed little interest in this development and, perhaps somewhat ungallantly, left all the arrangements to Pam. With little other assistance, Pam set about reorganising the entire library, moving nearly all of the many tons of books herself. A positive outcome was that, as a result, Pam had a wonderful grasp of where all the various volumes and serials were to be found, as she had first allocated all of the spaces, and then moved everything onto the shelves herself.

During her tenure Pam demonstrated not only first-rate librarianship but also, because of her earlier training in entomology alongside professional taxonomists, an excellent understanding of the needs and issues affecting systematic entomology, as it was practised during that period. This, plus her sunny disposition and remarkable patience, meant that she was soon much in demand from staff and visitors alike, gaining a reputation amongst entomologists as "an entomologists' librarian". Pam's special ability was wonderfully recalled at the time of her retirement by the late Vic Eastop who, lamenting, wrote "who will now tell me the author and date of "the small brown (before it was rebound) book with a picture of an aphid gall near the back, that before the library was extended, used to be on the second or third shelf down, in either the fourth or fifth row of book cases to the left of the door as you went in (or perhaps it was as you came out)"?" Pam really could make sense of such enquiries!

Pam also took a great interest in preserving manuscripts and other historical material, difficult "stuff" that entomologists seem able to generate in profusion. Under her guidance and leadership, the Entomology Library was one of the happier and more effective 'engine rooms' of the Museum. It was also a social connection, especially for smokers. Smoking was necessarily strictly forbidden throughout the entomology building, but 'les fumeurs' were allowed to indulge on the roof of the adjacent zoology 'Spirit Building', reached from a door very close to the library. Pam, a moderate smoker herself, often joined these alfresco gatherings, where many things, including museum gossip of course, were discussed.

The Department of Library Services

In 1975 all the Museum's subject libraries were brought together administratively into the Department of Library Services, headed by Librarian Maldwyn Jones ('Mal') Rowlands (1918–1995). Pam also served under the two subsequent head librarians, A.P. ('Tony') Harvey, and then Rex E.R. Banks. It was during Rex's tenure (1988–1996) that Pam was promoted, initially part-time, to Deputy Librarian. Pam's working relationship with Rex evolved into a lasting friendship. Well into retirement they used to meet at least once a year for a pub lunch in Westerham, Kent, a small town half

way between their respective homes – and this only ceased as Pam's lack of mobility due to arthritis worsened to the point where walking even a short distance had become just too painful to bear.

A key feature of the period when Pam was Deputy was the introduction of a large scale photocopying service that benefited an international research community. Before the era of the internet and electronic scanning, the only means of making available the content of antiquarian books and difficult to locate scientific journals and books to researchers who could not travel to specialist libraries, was to produce photocopies, sent by post. The Natural History Museum library during the 1980s and early 90s processed many thousands of such photocopy requests, with individual orders often listing hundreds of references. This major logistical challenge to library staff, checking and locating often obscure references, collating large orders and posting parcels to all parts of the world, was calmly managed by Pam. Many natural history books and papers published during this time fully acknowledge the important contribution of this photocopy service. In the late 1980s Pam was also instrumental in recognising that the library would need to adopt computer technology and, together with Rex Banks, they organised the scanning and transcription of hundreds of thousands of library catalogue cards into the first library database. This provided the foundation of the current on-line library catalogue which now benefits thousands of users every day via the internet.

Although the Natural History Museum, its libraries and their users were the core of Pam's professional life, it would be wrong to give the impression that her work was limited entirely to South Kensington. At various times Pam acted as Secretary to the ASLIB Biological Group, attended ASLIB conferences, and was a member of the Standing Conference of National and University Libraries (now the *Society of College, National and University Libraries*). Her involvement with various joint NHM, Hill House and Nokomis facsimile projects took her to Singapore and Australia, and she also visited Japan. Even so, there is no doubt that her focus was always very much in the Cromwell Road.

Group photograph, NHM Department of Library Services staff, *circa* 1980, taken on the steps of the Main Hall of the 1881 Waterhouse Building. In the centre of the front row, immediately to Pam's resplendent left is Tony Harvey (glasses), then Mal Rowlands (tallest), and Rex Banks (chequered tie). Immediately behind Pam, just slightly to her left, is Cindy Cogan. [Photograph: NHM London]

Publications

A group of entomologists with whom Pam developed particular rapport were members of the European lepidopterological union, Societas Europaea Lepidopterologica (SEL), a new society founded in Bonn in 1977. Starting the following year, Pam made 13 major contributions to SEL journals. These were annual bibliographical lists (sometimes with supplements) of publications on Lepidoptera that had appeared in Europe, or were relevant to the European fauna. In all cases Pam acted as editor, but also as a contributor. All were published under the rubric 'Bibliography of Palaearctic Lepidoptera', but in four different "series":

The first two (1978, 1979), for which Pam formally appeared as author, were published as papers in the Society's main journal, *Nota Lepidopterologica*. But from 1982, when the third part appeared, covering 1979–80, these bibliographies became the subject of a separate, more cheaply produced SEL serial – which had its formal title changed twice during Pam's involvement. In all these subsequent publications Pam was formally both Editor and one of the collective contributors. The seven annual parts published 1982–1988 appeared as *Bibliographia Europaea Lepidopterologica*, part 10 (in 1989) as *Bibliographica Palaearctica Lepidopterologica*, and the last three parts (1990–1992) as the eponymous *Bibliography of Palaearctic Lepidoptera*. These 13 bibliographic contributions under Pam's editorship amounted in total to 792 pages, listing approximately 10,000 references, and undoubtedly did much to foster and strengthen the nascent society. On reaching retirement, Pam stepped down as editor, and the series then underwent another metamorphosis, to become the *Index of Publications on European Lepidoptera* (which first appeared in 1995, for the years 1991–1992, numbered as part 14). Harald Schreiber has given a historical account of Pam's important contribution to the Society (*Societas Europaea Lepidopterologica (SEL) News – Nachrichten – Nouvelles* (43): pp.10,15,16, 2007). Pam was elected an Honorary Member of SEL in 1988.

Pam also co-authored a valuable source book for general entomology (Gilbert and Hamilton 1983, updated 1990), and a key work on manuscripts held in the library of the Natural History Museum London (Harvey, Gilbert and Martin 1996). However, remarkably, she is best known for her very first publication – *A Compendium of the Biographical Literature on Deceased Entomologists* (1978) and its continuation 30 years later, the companion volume *A Source Book for Biographical Literature on Entomologists* (2007).

What was initially "The biographical index of entomologists" was the subject of a publication proposal dated 29th June 1973 by David Ragge, then Deputy Keeper of Entomology at the NHM, at which time the book was expected to have 6500 entries and 14000 references. To commence your publication career at over 40 years of age with something so ambitious is surely most unusual – and fraught with academic danger. Such works, almost all 'data' and very little interpretation, are always subject to errors and omissions – and when first published, the work received various criticisms. Some were speculative. Thus Harold Oldroyd (*Journal of Natural History* 13(1): 122, 1979) wondered why two dipterists of interest to him, J.M.R. Surcouf and Gertrude Ricardo, were missing. Pam's 2007 volume has entries for both – but these were not written until many years after the original *Compendium* appeared! John Clark states that the *Source Book* includes over 8000 entomologists and 21,500 citations (*Archives of Natural History* 37: 181, 2010). The sheer scale of this undertaking is reflected in a personal letter to Pam from Michael Ruijsenaars of Backhuys Publishers, dated 27th November 2007: "With every new book we publish, I always have a sense of gladness … but … with your work, this feeling is considerably more poignant, in the knowledge of the enormous amount of work and time that you have lavished on this production."

A genuine and rather amusing source of error in the *Compendium* concerned the fact that, as Klaus Sattler recalls, "Pam did not [then] appreciate that Eastern European countries in particular often published eulogies to commemorate birthdays or retirements. Pam might have noticed that a surprising number of entomologists had 'died' on their 60th birthday … I myself knew four people who survived their 'death' by a good many years!" But in the total scheme of things such errors are mere peccadilloes. That these works remain so tremendously useful and so widely used, as Klaus observes, is testimony to their author's remarkable vision, tenacity and ability.

PAM, HAT, OBE, HM (1992: photographer unknown)

Retirement

Pam officially retired from the museum on 13th December 1992. Earlier that year she had been honoured in the Queen's Birthday Honours list with an OBE (Officer of the Most Excellent Order of the British Empire), announced in the *London Gazette* on 12th June. Some years earlier Pam had moved south of the river to the Croydon area, good for commuting by rail. But after retirement she relocated even further south, to Warlingham, a leafy, outer London suburb set amongst the North Downs. By this time she had learned to drive, and would set out in her little car soon after 5 am to make the 25 km journey to South Kensington. Arriving by 6.30 she became very well-known to museum security staff. This remarkable strategy for someone supposedly in retirement enabled her to produce several more publications, some of them very substantial (see Bibliography).

Due to her increasing mobility problems, as the years passed, Pam's visits to Cromwell Road became less frequent. Her general health started to deteriorate, but she was still absolutely determined to pursue her bibliographical endeavours. In the end only the car made this possible, reducing painful walking to an absolute minimum. Although her last recorded publication appeared in 2012, she continued working to the very end, most notably transcribing the correspondence of the 18th century silversmith and entomologist Dru Drury. Pam died shortly before her 83rd birthday, on 8th December 2015, at Redhill, Surrey.

Retirement: Pam at home [Photograph: Noleen Glavish]

Memories and Reflections

At the time of her retirement, Laurence Mound, then Keeper of Entomology, wrote of Pam: "To me you have always epitomised the Natural History Museum – outstanding scholarship, worn lightly and with unfailing courtesy and humour, but with clarity of purpose and determination. Sharing your career has given me much inspiration, enlightenment – and sheer pleasure". Memoranda in the Museum's archives from the period of her first establishment as Entomology Librarian, notably by Turpin, Clifton, China, Riley and Freeman, reveal that Pam was always regarded in the same positive light by her colleagues.

Thus, in support of her promotion from Senior Scientific Assistant to Experimental Officer (for an insight into the structure of UK civil service science at that period, see *Science* 124(3222): 567–571, 1956), Paul Freeman wrote to the Museum Director on 9th June 1969: "Miss Gilbert is an educated, intelligent woman, well up to E.O. standard, conscientious in her work and has been a great asset to the smooth running of the Library … She is particularly noted for the helpful way in which she will go to endless trouble to assist enquirers, regardless of their rank and has shown considerable skill at times in handling what could be difficult cases". Proof that Pam never lost this skill comes from a recent email by one of those many "enquirers", the extraordinary Australian lepidopterist and publisher Bernard d'Abrera:

"Thank you for the most important item of news regarding the passing of our great mutual colleague, Pamela Gilbert OBE. What a magnificent person she was, both professionally and socially. I never once saw her lose her temper or be ungracious to anyone. I've seen her provoked

beyond human endurance, and every time there was this gentle smile, followed by that famous deep baritone chuckle. The sparkling eyes and the challenging look which made the offender feel gently but firmly corrected – I was one of them on several occasions when I pushed my luck a little too far. She never once denied me any assistance that I might have sought, and was always on hand to guide and help through several of my seemingly outrageous projects." [Bernard d'Abrera, in litt., 2016.]

And it was through the d'Abrera connection that Pam first met Noleen Glavish, when she travelled to Melbourne for the launch of the Hill House Banks/Cook Portfolio (Gilbert, ed., 1990). As Noleen recalls, "Pam and I became instant friends when we met. She stayed at my house during that visit. I later visited London three times during the following four years and stayed with Pam – and we dug out the Bauer Collection. But as time went on my relationship with Pam was not so much business but a friendship, and I always visited her and often stayed at her house after Nokomis published the Ferdinand Bauer Collection prints in 1994. We used to sit for hours far into the night talking about all manner of things. If I hadn't met Pam I wouldn't be publishing today – she was the driving force that got me to publish the Bauer Collection and it moved on from there. So I owe her a great deal."

Cindy Cogan, who worked in the Entomology Library at the end of the 1960s, recalls Pam thus: "I had been working on the Coleoptera Section for three years and I had to go to the Library to sort out a map reference. Pam passed by and just asked if I had found what I was looking for and we started to chat. I commented that I was a bit fed up with my current job and later, due to Pam's recommendation, I was offered a post in the Entomology Library. She was my boss for two years, and taught me everything I needed to know to enable me to survive the everyday functioning of a specialist library. She created a happy atmosphere and we worked together as a team. Pam was very generous and at Christmas she would take me out for a meal. She had a great sense of humour and we were always laughing, and she could always see the funny side of the absurd. During the dreaded 'book checks' she was often to be seen up the ladders, sharing all the work, and never made me feel that I was only her assistant. Whenever I came back from leave, I found that most of my everyday work had been kept up-to-date and I was not greeted by a desk piled so high that I didn't know where to start. Pam was also a great cook, and when we organised leaving parties it was always great fun, as she made the best sausage rolls I've ever tasted! I'm so glad that I knew Pam and shared part of my life with her." Cakes were also a speciality – so much so that Krystyna Plater recently referred to these works of culinary art as "Pamtastic!"

Indeed, Pam Gilbert was a truly fantastic colleague, one of the very best, and her passing is mourned not only by numerous present and previous museum staff, but literally thousands of visitors to the museum who had need, reason or desire to access the Museum's entomological library, or better understand the literature of natural history.

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A new species of the genus *Spiniphallellus* Bidzilya & Karsholt, 2008 (Lepidoptera, Gelechiidae, Anomologini)

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http://zoobank.org/1D3C9A82-F60C-4172-AC62-DB2E374F1ABB

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Abstract. *Spiniphallellus chrysotosella* **sp. n.** (Gelechiidae: Anomologini) is described. The species is recorded from Bulgaria, Georgia, and Turkey. All three localities of *S. chrysotosella* are rather similar dry rocky slopes where *Jasminum fruticans* L., 1753 (Oleaceae) is a dominant shrub. It is also expected to be the host plant of the new species.

Introduction

The genus *Spiniphallellus* was described and its members diagnosed by Bidzilya and Karsholt (2008) and it was placed in Anomologinae, one of the subfamilies of Gelechiidae. The genus was established for three species collected from mountainous and desert areas of Palaearctic Asia: *S. desertus* Bidzilya & Karsholt, 2008 (Uzbekistan, Turkmenistan, Kazakhstan), *S. stonisi* Bidzilya & Karsholt, 2008 (Kazakhstan), and *S. fuscescens* Bidzilya & Karsholt, 2008 (Turkey). Later on, Šumpich and Skyva (2012) reported *S. desertus* from European Russia. Here a new species of the genus, viz. *S. chrysotosella* sp. n. is described. All these species have specific structures of the genital organs which are typical for the Anomologinae, such as a reduced gnathos, a relatively short valva closely connected to the tegumen, a short tegumen and a well-developed transtilla lobe (Piskunov 1975: 857; Povolný 1979: 44). The new species was recorded for the first time with one specimen from Turkey, Anatolia 01.v.1996 during a sunny day around 10 a.m. It was caught by netting *Jasminum fruticans* L., 1753 (Oleaceae) vegatation on a small dry, rocky hill area. This specimen remained undetermined for several years until three additional specimens were found from Caucasus (Georgia, Gremi) 23–25.v.2011 (Fig. 4). The habitat was again a dry rocky slope with plenty of *Jasminum fruticans*. The specimens were found resting on the leaves of *Jasminum* around 10 a.m. on a bright warm sunny day.

At the end of April, 2013, two additional specimens were found on *Jasminum fruticans* vegetation on the Rupite volcanic hill area near the town of Petrich in SW Bulgaria, Blagoevgrad district. The weather was unusually hot, over 30 degrees Celsius still at dusk. The specimens were attracted by artificial light during the first dark hours.

Zdenko Tokár proposed that the specimens should belong to the genus *Spiniphallellus* and the study of the known species of the genus justified the description of the new species, here named as *Spiniphallellus chrysotosella* sp. n.

Spiniphallellus chrysotosella sp. n.

http://zoobank.org/30102FE9-4C78-4DB7-87CC-6608F85966BC

Material. Holotype: ♂, **Bulgaria** SW, Struma River valley, Rupite, 41.462°N; 23.256°E, 30.iv.2013. J. Junnilainen leg & coll.: GPJJ201578 and red label "HOLOTYPE of *Spiniphallellus chrysotosella* Junnilainen". – Paratypes: 1 ♂, same locality and data as holotype with green label DNA sample 24244 Lepid Phyl.; 3 ♂, **Georgia** Gremi 42.002°N; 45.657°E, 23–25.v.2011 J. Junnilainen leg., Coll. J. Junnilainen. 1 ♂, **Turkey**, Anatolia, Manavgat, 36.788°N; 31.416°E, 01.v.1996 K. Nupponen & J. Junnilainen leg., Coll. J. Junnilainen. Gen Prep No.7126 Bo Wikström. All paratypes with red label "PARATYPE of *Spiniphallellus chrysotosella* Junnilainen".

Description. Adult (Fig. 1). Wingspan 9–9.5 mm. Labial palp brown with golden shine. Antenna brown, slightly serrate. Head, tegula, and thorax dark brown with glossy golden and purple hue.

Forewing brown with golden shine, with five shiny golden spots: three on the costa, one at 1/5 length of wing from base extending to fold, second at middle of costa, and third 2/3 from base; two spots in fold: one at 1/3 wing length from base and second at 3/5 from base. Hindwing fuscous. Abdomen and legs brown somewhat shiny golden.

Male genitalia (Figs 2, 3). Sternite VIII broad sub-rectangular, laterally rounded, with broad anterior projections on both sides, posterior margin broadly rounded with weak medial indentation. Tegumen relatively short with V-shaped anterior margin; uncus formed as almost sub-rectangular plate, except with posterior margin broadly extended medially, latero-medially with two strong setae and with 6–8 short and thinner setae; valva twice as long as tegumen, elongate, apical half

Figure 1. Adult of *S. chrysotosella* sp. n. (Paratype).

Figures 2–3. Male genitalia of *S. chrysotosella* sp. n. **2** Unrolled male genitalia. **3** Phallus.

Figure 4. Habitat of *S. chrysotosella* in Georgia, Gremi.

strongly hirsute, apex sharp, weakly pointed inwards; transtilla lobe relatively long, digitate, apically with some fine setae; posterior margin of vinculum medially with broad rounded indentation, laterally formed as sub-triangular plate, distally covered with fine setae; saccus broad, rounded; basal half of phallus almost round, distal part relatively slender, tapered apically; ankylosed by strongly sclerotized and tightly attached anellus.

Diagnosis. Externally the new species is characterized by its forewing with gold shiny markings, which are absent in other close relatives. The species differs from *S. fuscescens* Bidzilya & Karsholt, 2008 by its longer and slenderer valva, longer transtilla lobe and by the form of its vinculum; from *S. stonisi* it differs by its broader uncus, slenderer valva and by distinctive transtilla lobes, lacking in *S. stonisi*; and from *S. desertus* it differs by its slenderer valva, narrower shape of the transtilla, and more rounded saccus.

Female genitalia. Unknown.

Distribution. Bulgaria, Georgia, and Turkey.

Biology. Early stages are still unknown although *Jasminum fruticans* seems to be the most probable host plant. The imago is mostly day active. Flight period begins at the end of April or beginning of May. *S. chrysotosella* has probably been overlooked due to its small size and because it is apparently diurnal and might not be usually attracted to lights.

Etymology. The species name is derived from its golden shiny forewing markings, which are absent from other related taxa.

Remarks. *Spiniphallellus* was originally named based on the characteristic thorn or spine laterally in the medial part of the phallus. This process, however, is actually a strongly sclerotized part of the anellus, tightly fused to the phallus. The phallus is very difficult to remove during dissection without breaking the juxta-anellus complex.

The DNA barcode (sample ID MM24244) shows a very clear difference to all other moths in BOLD (www.barcodinglife.org). The nearest species is *Diasemia grammalis* Doubleday, 1848, which is an exotic Crambiinae moth differing by 8.16%. This barcode difference is so large that its placement is not considered meaningful. No other species of *Spiniphallellus* has been barcoded so far.

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