



Recognition of some misidentifications and of three new species of Palaearctic scuttle flies (Diptera: Phoridae)

R. Henry L. Disney

Department of Zoology, University of Cambridge, Downing Street, Cambridge, CB2, United Kingdom
3EJ, U.K.; e-mail: rhld2@hermes.cam.ac.uk

Article History

Received: 14 October 2018

Accepted: 06 December 2018

Published: February 2019

Citation

R. Henry L. Disney. Recognition of some misidentifications and of three new species of Palaearctic scuttle flies (Diptera: Phoridae). *Species*, 2019, 20, 39-58

Publication License



© The Author(s) 2019. Open Access. This article is licensed under a [Creative Commons Attribution License 4.0 \(CC BY 4.0\)](https://creativecommons.org/licenses/by/4.0/).

General Note

Article is recommended to print as color digital version in recycled paper.

ABSTRACT

The recognition of *Aenigmatiasdorni* (Enderlein) is clarified. *A.pyrenaicum* (Becker) is rescued from synonymy with *A. dorni*. *A.necdornisp. nov.* is described from Poland. *A.marinaaesp. nov.* and *A.taigaensissp. nov.* are described from Russia. *Megaseliaintrolapsa* Schmitz is synonymized with *M.xanthozona* (Strobl), the identity of *M.monochaeta* (Strobl) is clarified and distinguished from *M.riefi* Brenner. *M.quintincisa* Disney is synonymized with *M.subnudipennis* (Schmitz).

Keywords: Diptera, Phoridae, *Aenigmatias*, *Megaselia*, new species, new synonyms

1. INTRODUCTION

The advance in knowledge of scuttle flies (Diptera, Phoridae) continually reveals new species and synonyms. The latter often result from males and females having been assigned to different species. Sometimes the male and a female of different species have been assigned to a single species. Sometimes the incorrect recognition of new species has been due to the range of variation being such that different individuals run down in different places in existing keys. In this paper I report on recently recognized examples of these confusions.

2. REPORT

What is *Aenigmatias dorni* (Enderlein)

The ancient genus *Aenigmatias* Meinert has several species known from the Eocene (Brown, 2016). Today's species are parasitoids of ant pupae or adults. I provided the most recent key to the males of these species (Disney, 2002). Two American species has since been added (Disney et al., 2011, Disney, 201x). The flightless females remain unknown for several species. In dealing with a further new European species (Jancík & Disney, 201x) it was necessary to compare it with specimens attributed to *A. dorni* (Enderlein, 1908). This highlighted problems with recognition of *A. dorni*.

THE RECOGNITION OF *AENIGMATIAS DORNI*

There are two problems with the recognition of Enderlein's species. First, his collection of Phoridae was destroyed by a bomb in the Second World War. Second, he described the species from the female only. Schmitz's (1941) Textfig. 72 reproduced Enderlein's figure of his female. A feature in this figure invites comparison with other females. This is considered below. The greatest width of the thorax is about 1.4 times the width of the head. I have borrowed slide mounts (from the Museum Koenig, Bonn) of a female illustrated (without scale bars) by Schmitz (1955, Textfigs 209 & 210) and report its ratio to be 1.38. For the female of the species attributed to *A. dorni* by Gotô & Takeno (1983), later assigned it to *A. gotoi* Disney (2002) based on a pair caught *in copula*, and kindly donated by Gotô. For this female the equivalent ratio is 1.9 times. The specimens identified as *A. dorni* by Michailovskaya (2004a & b) were based on a pair caught *in copula* on 15-16.vii.2000 and 2 males and 2 females, from the same locality, caught on 21-31.vii.2000. For the female caught *in copula* the ratio is 2.0. For the later 2 females the ratios were 1.65 and 1.67. It is concluded that the female illustrated by Schmitz is the same as Enderlein's figure. This is the species associated with the ant *Formica rufibarbis* Fabricius.

Currently species recognition is primarily based on males. Species similar to *A. dorni* have the basal half or more of the hind femur straw yellow and brown palps. These males all have hypopygia that are essentially the same, apart from *A. lubbockii*, whose upper posterior process of the epandrium is distinctly, but somewhat variably, more tapered than in the rest of this complex (Figures 3A & B). 5 males of *A. lubbockii* from England and one from Norway indicate the following ranges of variation. The length of the front basitarsus divided by the length of the front tibia ranges from 0.59 to 0.69 (mean 0.64); the number of axillary bristles from 6 to 12 (mean 8-9) and the number of hairs on vein 3 from 5 to 17 (mean 9). This serves to exclude all the rest of the complex except for *Aenigmatias pyrenaicum* (Becker). This species was synonymised with *A. dorni* (Disney, 2002) before it was realized that Schmitz's (1941) description of this species embraced more than one species. Having re-examined the holotype of *A. pyrenaicum* (Museum für Naturkunde, Berlin) it is herewith rescued from synonymy with *A. dorni*.

The question arises as to the identity of the males of the two Russian species and other males attributed to *A. dorni*. In the key to males (Disney, 2002) at first sight these can be divided into two groups based on the number of axillary bristles on the wing. Some have 6 bristles but others have 9-12 axillary bristles as in Schmitz's (1956) Taf.VIII Fig. 91. The Russian male caught *in copula* has 6 bristles but the other two Russian males have 9-12 bristles. The new species from Slovakia (*A. exregina* Disney) and a male from Poland both have 6 bristles. The number of hairs on vein 3 also varies from 6 to 34. To evaluate the reliability of these variable features the following specimens of *A. lubbockii* (Verrall) have been considered. 3 males from Norfolk associated with 2 females, a male from Berkshire and a male and 3 associated females from Norway. The axillary bristles number 6-12, the vein 3 hairs 5-17.

A less variable character in the males of this genus is the ratio of the length of the basitarsus to that of the front tibia. For the above *A. lubbockii* it is 0.59-0.67. For the male of *A. gotoi* caught *in copula* the ratio is 0.86. Schmitz (1956) reported this ratio to be 0.75-0.80 for '*A. dorni*'. In the new species from Slovakia, the Russian species caught *in copula* and a male from Poland this ratio is 0.73-0.74. For the other males from Russia the ratio is 0.82-0.85.

A further consideration is that Schmitz (1955) gives the ant hosts as *Formica glebaria* Nylander and *Formica rufibarbis*. Neither of these ant species is recorded from the Far East of Russia. This reinforces the perception that at least two species covered by Schmitz were being confused.

It is concluded the *A. dorni* of Schmitz (1955) represents at least two species and likewise with those attributed to *Adorni* by Michailovskaya (2004a & b). The newly recognized species are described below and the recognition of the true *A. dorni* clarified.

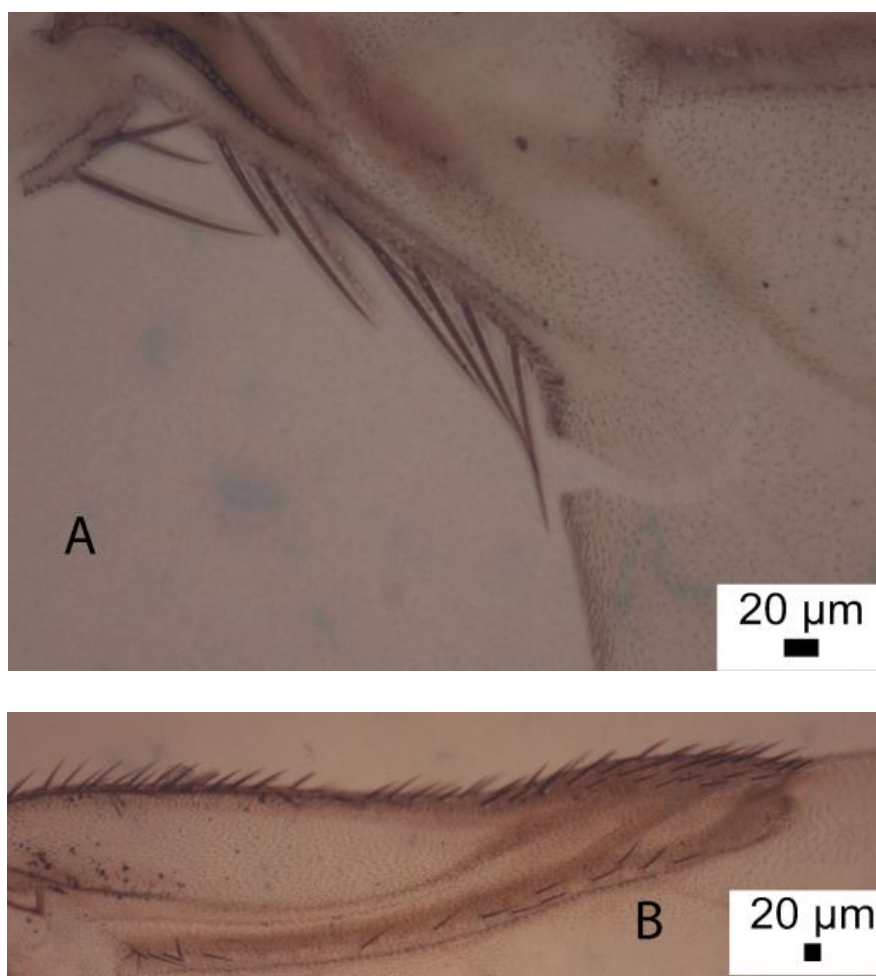


Figure 1 *Aenigmatiasdorni* male. A, wing base; B, vein 3.

***Aenigmatiasdorni* (Enderlein) (Figure 1)**

Oniscomyiadorni Enderlein, 1908: 148 (female).

Diagnosis. Male. Front basitarsus 0.75-0.8 times as long as tibia. Wing with 9-12 axillary bristles (Figure 1A) and vein 3 about 2 dozen hairs (Figure 1B). Female. Width of thorax is less than 1.6 times the width of head. Front basitarsus 0.54 times as long as tibia.

Material examined. Slide mounts of wing from male, Netherlands, Sittard, with *Formica rufibarbis* (Museum Koenig, Bonn, 000-40-481) and of female, Luxembourg, 17.vii.1902, from *F. rufibarbis*, P. Kohl leg (Museum Koenig, Bonn. 000-40-474).

Ant host. *Formica rufibarbis* Fabricius.



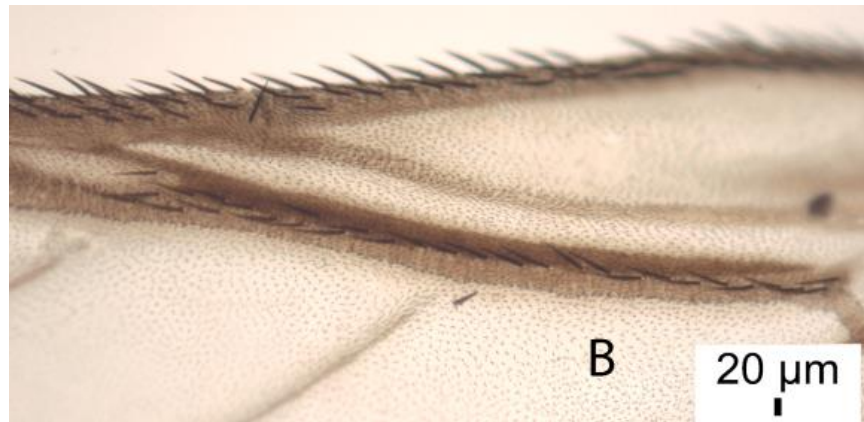


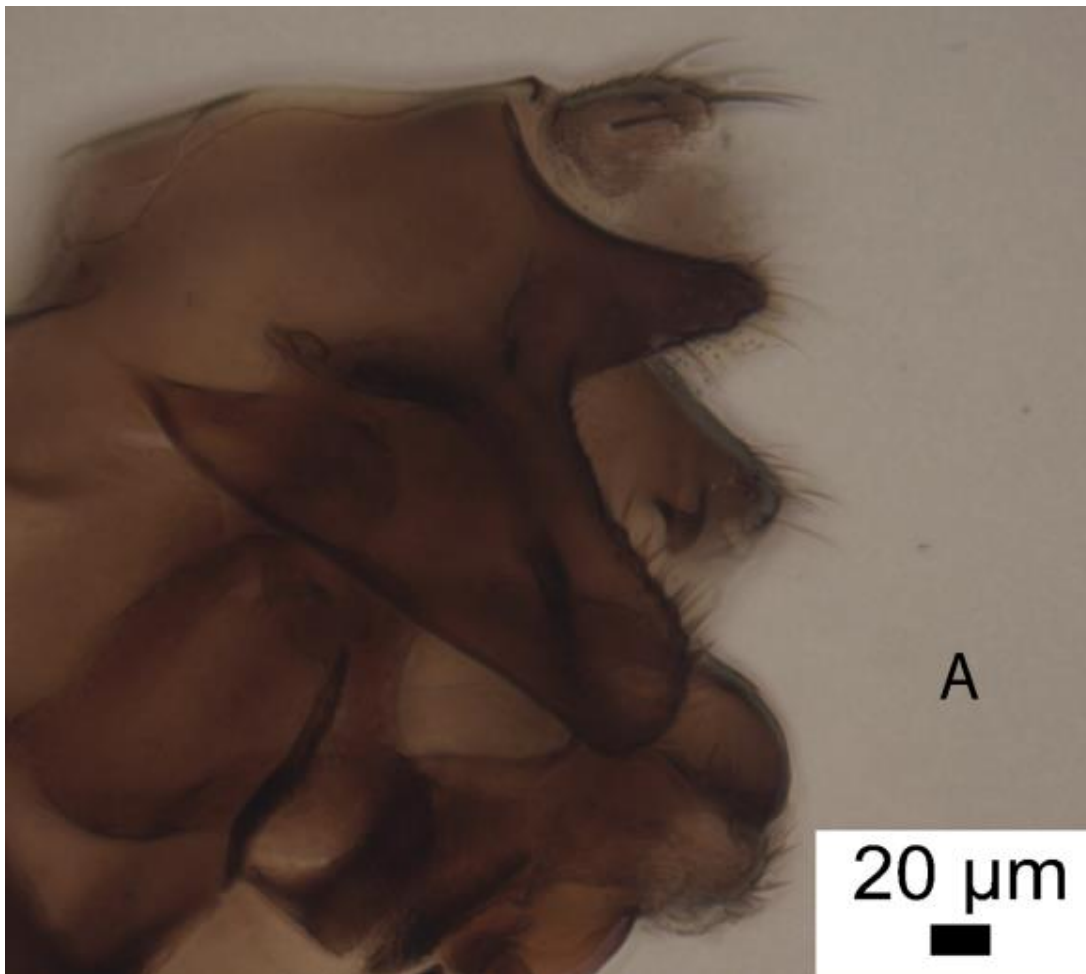
Figure 2 *Aenigmatiasgotoi* male. A, front leg; B, wing vein 3.

***Aenigmatiasgotoi* Disney** (Figure2)

Aenigmatiasgotoi Disney, 2002: 69.

Diagnosis. Male. Front basitarsus 0.86 times as long as front tibia (Figure 2A). With 6-7 axillary bristles. With about 30 hairs on vein 3 (Figure 2B). Female. Width of thorax 1.9-2.0 times width of head. Front basitarsus 0.45-0.50 as long as tibia.

Material examined. Paratype male and female (University of Cambridge Museum of Zoology).



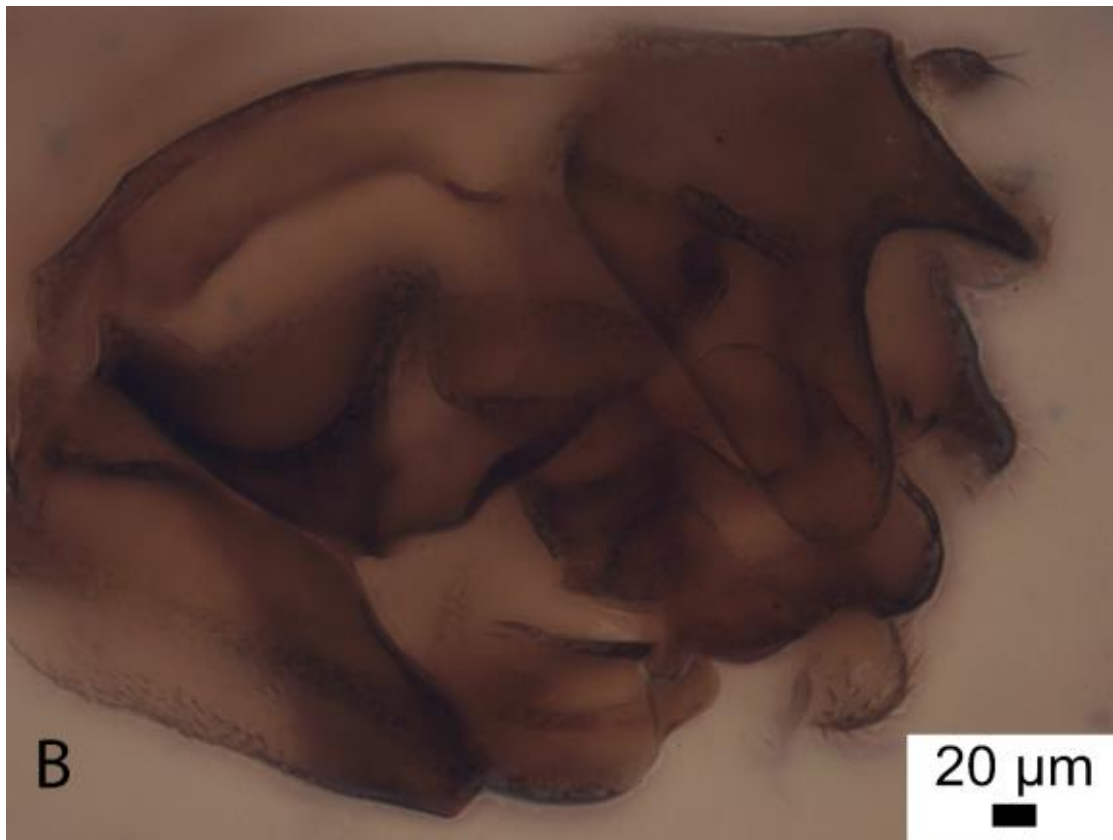


Figure 3 *Aenigmatiaslubbockii* male. A & B, hypopygia of two different males

Aenigmatiaslubbockii (Verrall) (Figure3)

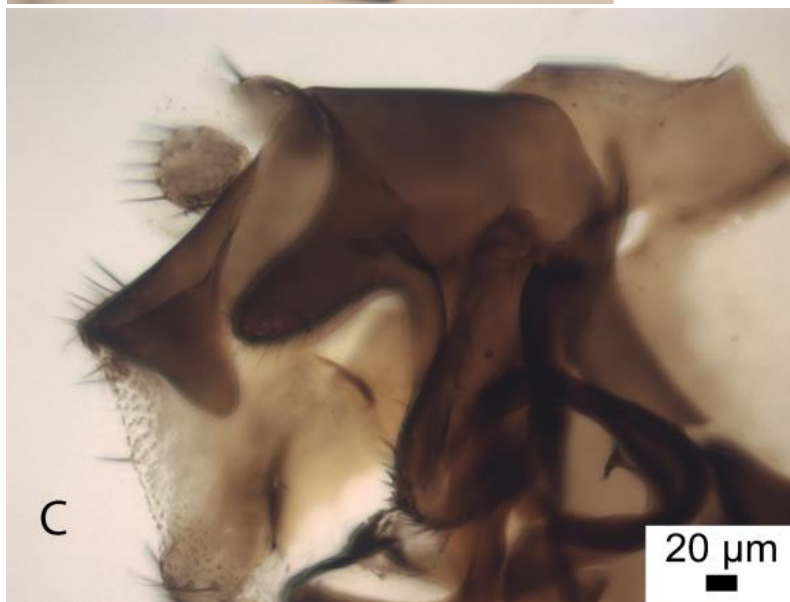
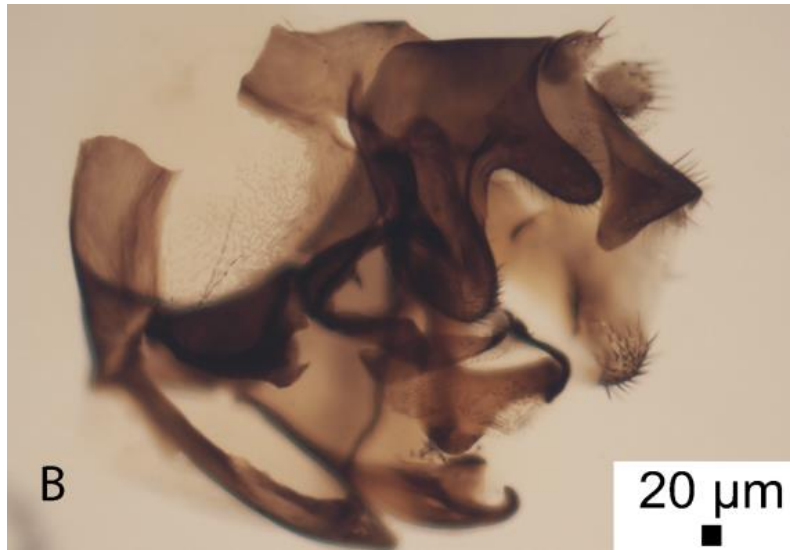
Platyphoralubbockii Verrall, 1877: 260 (male).

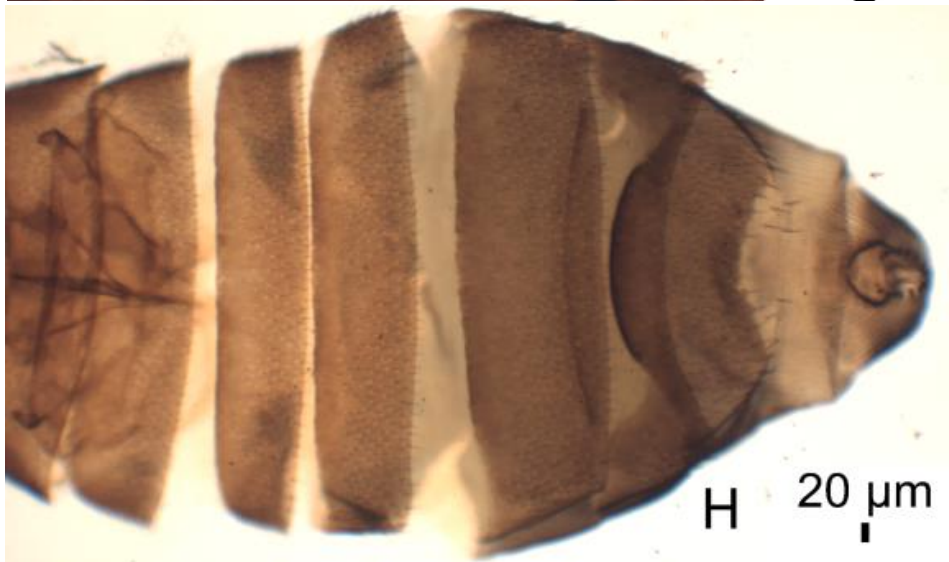
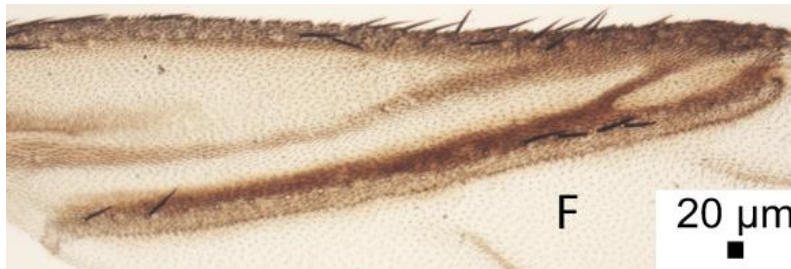
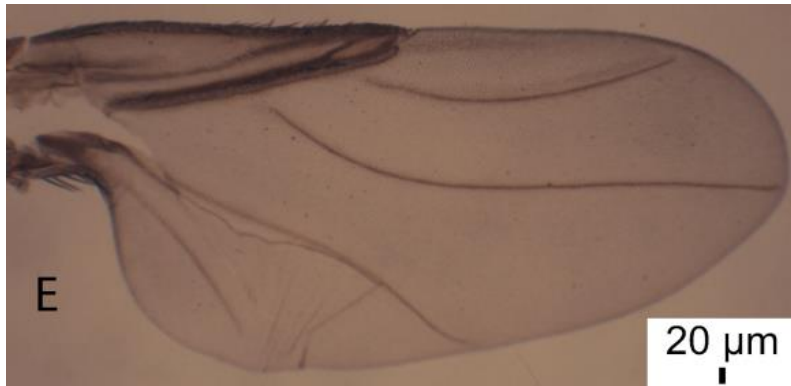
Aenigmatiasblattoides Meinert, 1890: 213 (female).

var. *highlandicus* Schmitz, 1914: 543.

Aenigmatiaslubbocki (Verrall). Schmitz, 1929: 6. Incorrect spelling (cited by Borgmeier, 1968 and subsequent authors). Chandler, 1998: 97.







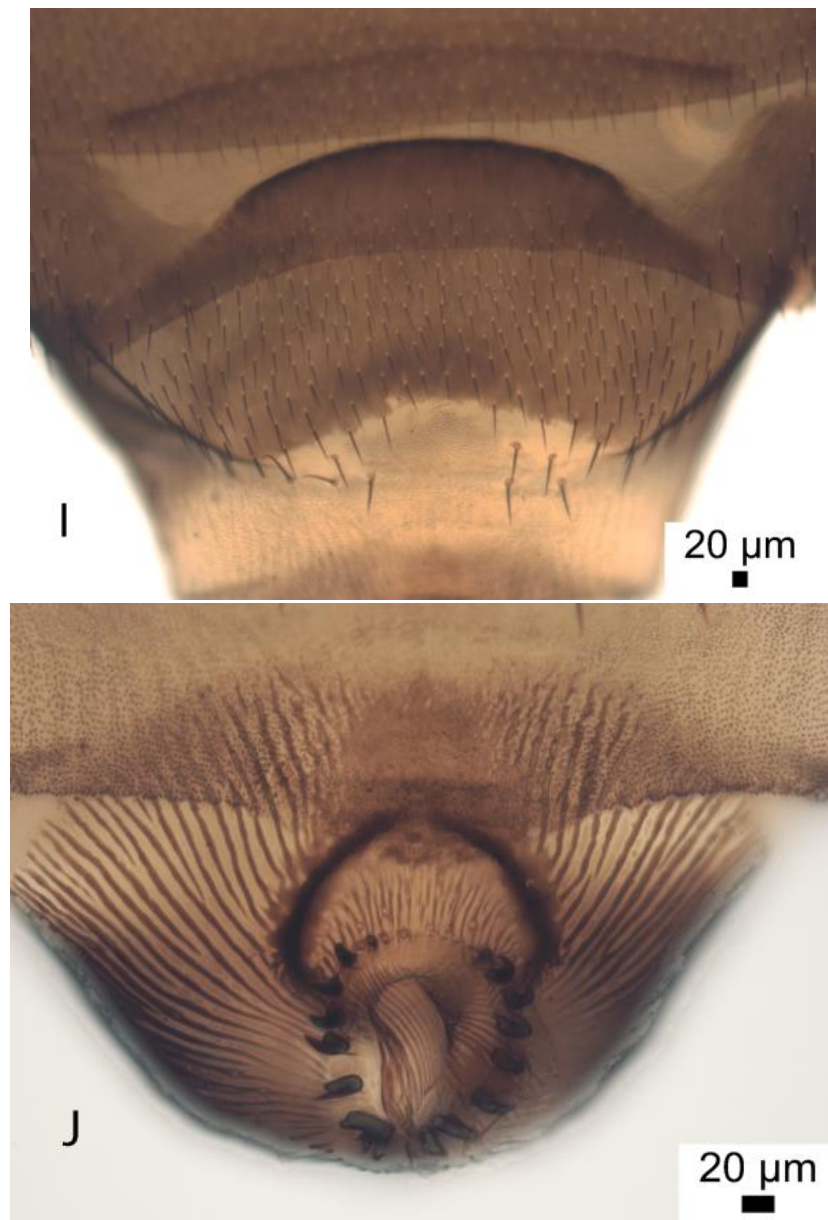


Figure 4 *Aenigmatiasmarinae*. A-F, male. A; antennae and palps; B-C, hypopygium; D, front leg; E, wing; F, vein 3. G-J, female. G, head; H, abdomen; I, tergite 6; J, tail end

The Figs 14-17 in Disney (1983a) were based on voucher specimens in the Hope Entomological collections, Oxford University.

Diagnosis. Male. Epandrium with tapered upper posterior process (Figures 3A & B). Front basitarsus 0.59-0.67 as long as front tibia. 6-12 axillary bristles, 5-17 hairs on vein 3 (Figure 3C).

Material examined. 5 males, 3 females from England (4 males, 2 females (University of Cambridge Museum of Zoology). 1 male, 2, females from Norway (University of Cambridge Museum of Zoology).

Ant host. *Formica fusca* Linnaeus.

***Aenigmatiasmarinae* Sp. nov.** (Figure 4)

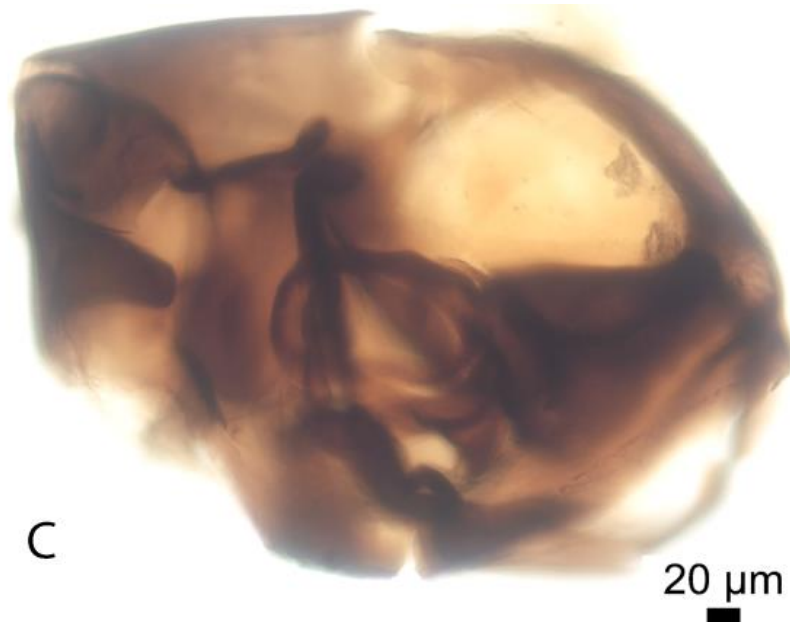
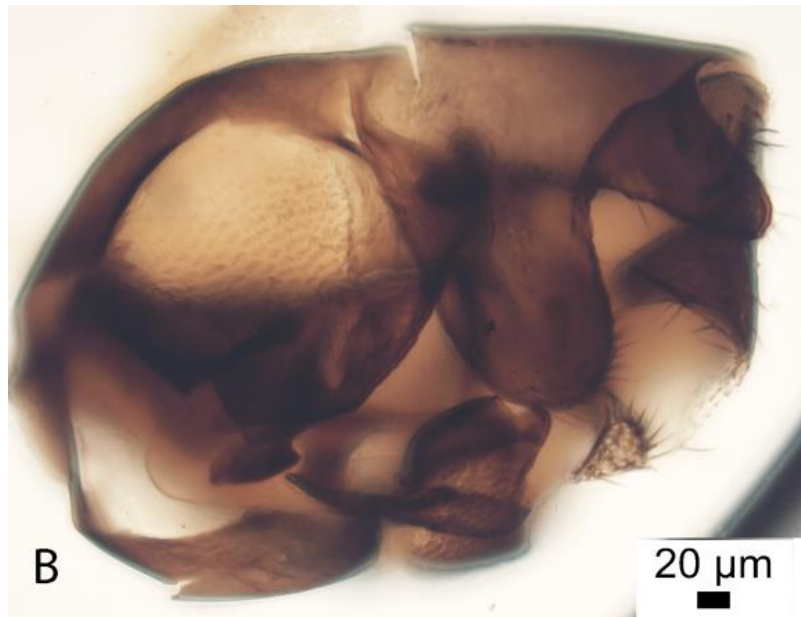
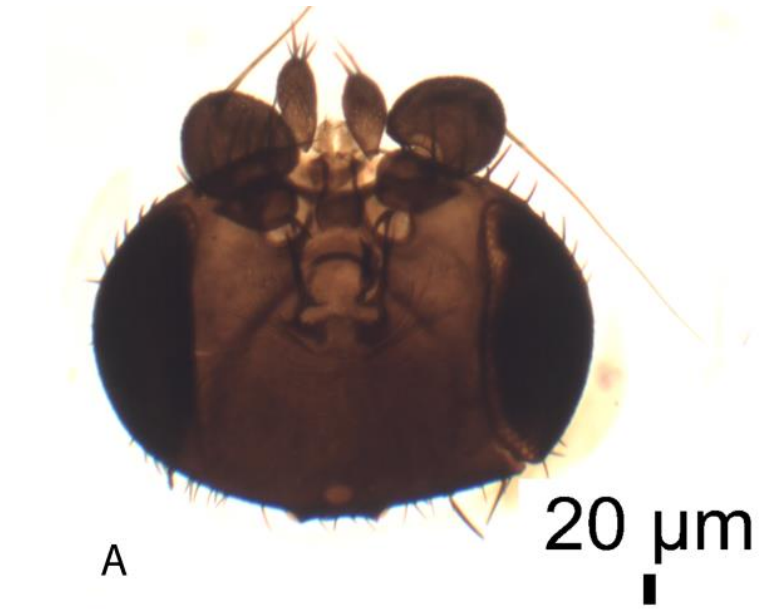
Diagnosis. Male. Front basitarsus 0.73-0.74 times as long as tibia. Wing with 6 axillary bristles and vein 3 with 2 dozen hairs.

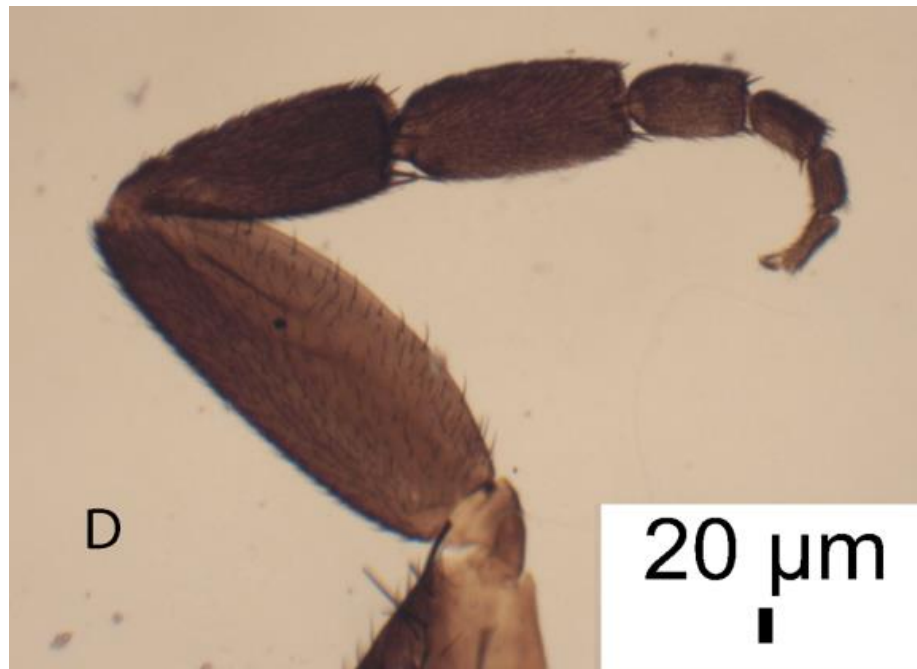
Male. Antennae and palps as Figure 4A. Hypopygium as Figures 4B & C. Front leg as Figure 4D. Wing (Figure 4E) 2.3-2.4 mm long. Costal index 0.54. Vein 3 as Figure 4F.

Female. Width of thorax is less than 2.0 times the width of head. Front basitarsus 0.40 times as long as tibia.

Material examined. Holotype Male, RUSSIA, PrimorskiyKrai, Gornotayozhnoe, Mountain Taiga Station, 43°63'N, 132°25'E, 15-16.vii.2000, M. V. Michailovskaya (University of Cambridge Museum of Zoology). Paratype female caught *in copula* with holotype.

Etymology. Named after Marina Michailovskaya who collected the specimens.





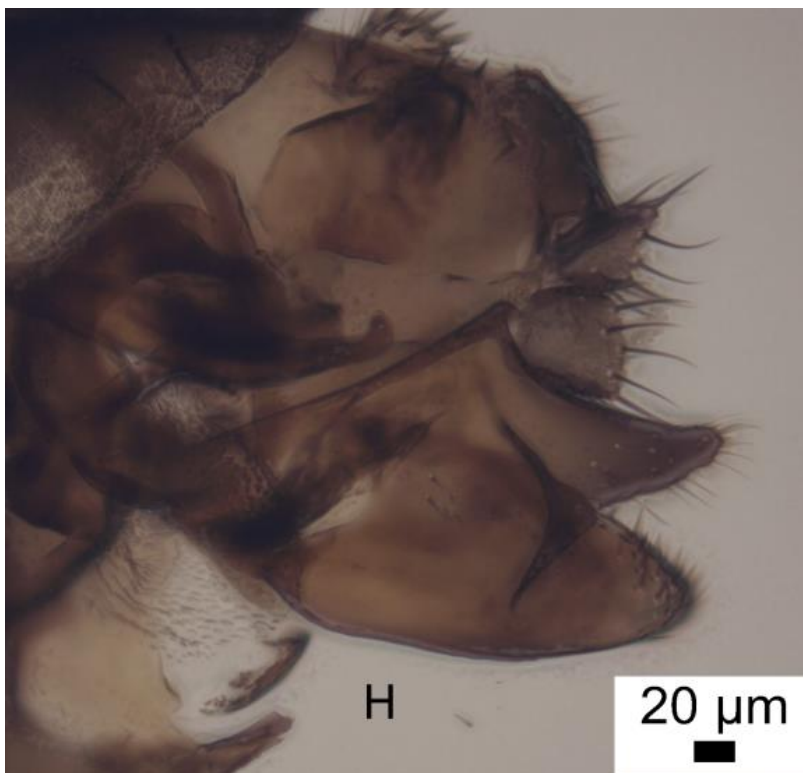


Figure 5 *Aenigmatiasnecdorni* male A-G. A, head; B-C, hypopygium; D, front leg; E, hind femur; F, wing; G, vein 3. H, *A. Exregina* hypopygium

***Aenigmatiasnecdorni* sp. nov. (Figure 5)**

Aenigmatiasdorni Schmitz, 1955: 364. Misidentifications in part.

Aenigmatiasdorni (Enderlein, 1908: 143). Michailovskaya, 2004a: 44. Misidentifications in part.

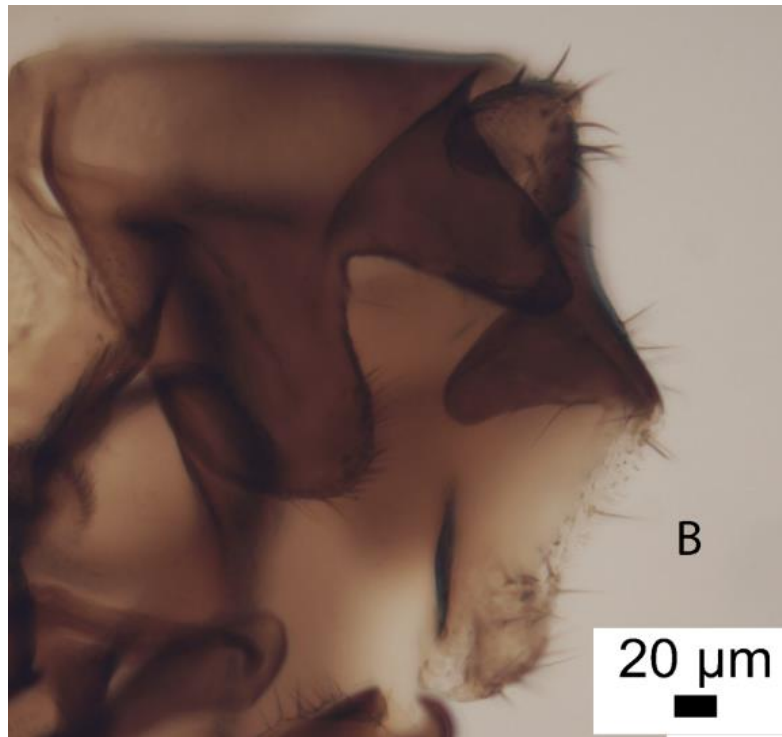
Diagnosis. Male. Front basitarsus 0.81 times as long as tibia. Wing with 6 axillary bristles and vein 3 about a dozen hairs. The hypopygium closest to *A. exregina* (Figure 5H).

Male. Figure 5A, head. Figures 5B-C, hypopygium. Figure 5D, front leg. Figure E, hind femur. Wing (Figure 5F) 2.1 mm long. Costal index 0.50. Vein 3 as Figure 5G.

Material examined. HOLOTYPE male, POLAND, Polanla, Inowrocton-Mgtwy Stonowiska, 30.iv.1972, R. Szadziewski (University of Cambridge Museum of Zoology)

Etymology. Named after being confused with *A. dorni*.





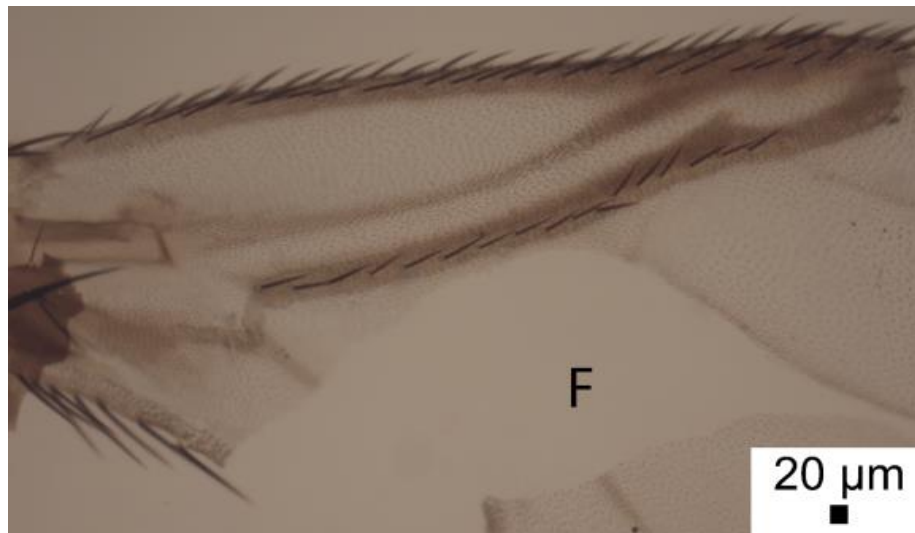


Figure 6 *Aenigmatiaspyrenaicum* male. A, head; B, hypopygium; specimens; C, front leg; D, front tibia and tarsal segments 1-2; E, hind femur; F, wing base.

***Aenigmatiaspyrenaicum* Becker (Figure 6)**

Psalidesmapyrenaicum Becker, 1912: 330 (male).

This species is herewith rescued from synonym with *A. dorni*.

In the holotype vein 2 is reduced to a remnant at its base so that vein 3 is unforked. This is undoubtedly a developmental fault. Among the males of *A. lubbockii* examined (see above) one has vein 2 incomplete distally, but the specimen is otherwise typical of that species.

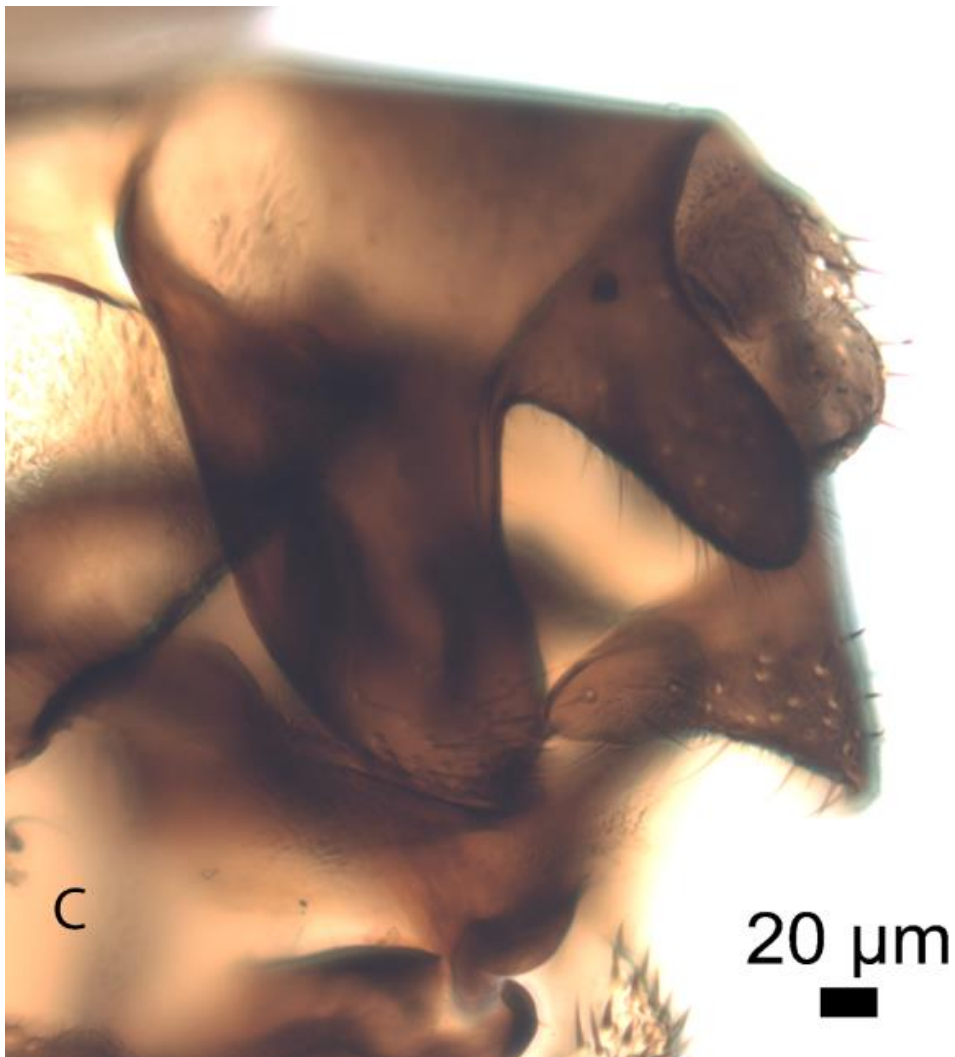
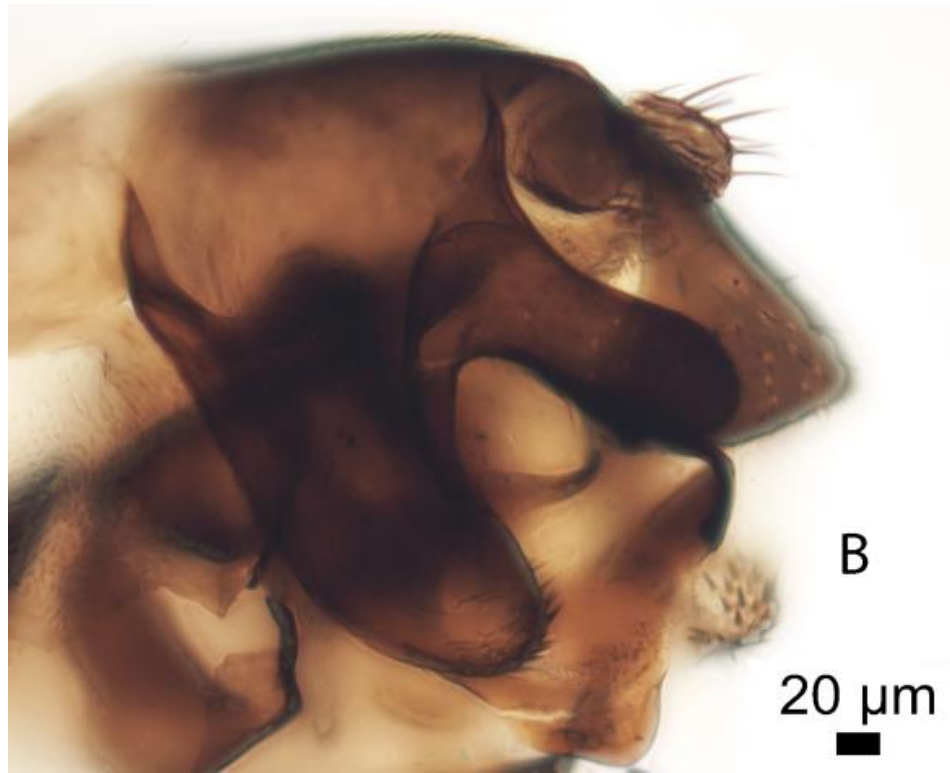
Diagnosis. Male. Front basitarsus 0.64 times as long as tibia. Wing 2.27 mm long, costal index 0.51, with 6 axillary bristles and vein 3 with 17 hairs. Hypopygium as Figure 6B.

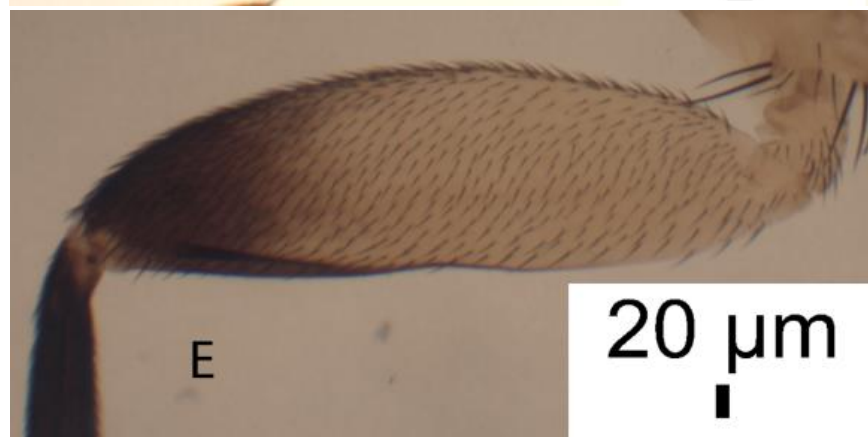
Material examined. HOLOTYPE male, FRANCE, Pyrenees, Cauterets, 14.VII.1901 (Museum für Naturkunde, Berlin).

***Aenigmatiastaigaensis*. Sp. nov. (Figure 7)**

The number hairs on vein 3 of the two males are 14 in one and 33 in the other. The upper lobe of the epandrium is a little different in the two males (Figures 7B & C). In the distinctive *A. lubbockii* this process also differs a little (Figures 3A & B). Otherwise the two males appear to be the same but somewhat variable species with regard to the hairs on vein 3. It is, however, possible that these represent a pair of sibling species. The use of molecular barcodes for further specimens (based on middle legs detached before the rest of the specimens are slide mounted) would be likely to resolve this.







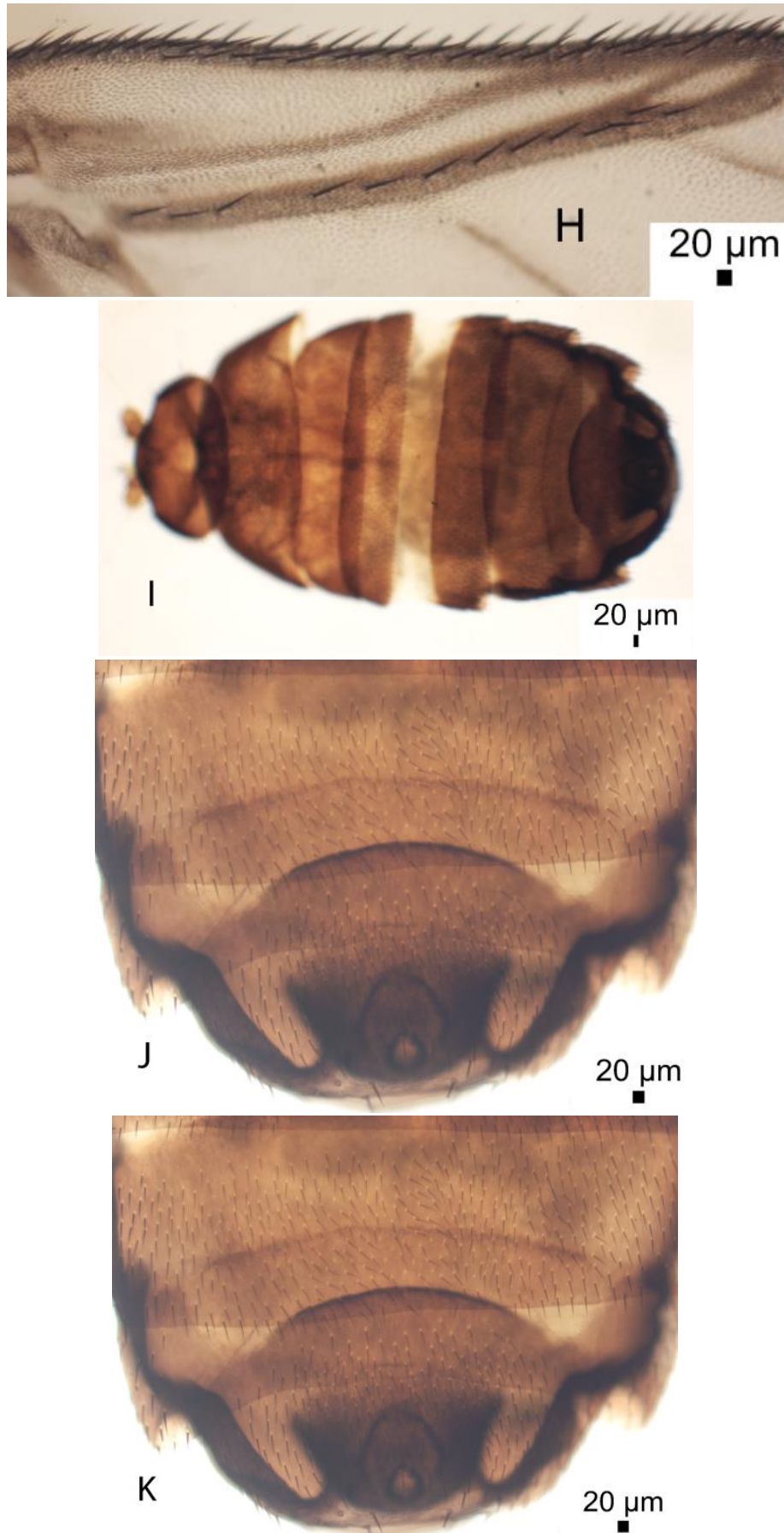


Figure 7 *Aenigmatiastaigaensis*. A-G, male:-A, head; B-C, left faces of hypopygia of two different specimens; D, front leg; E, hind femur; F, wing; G-H; vein 3 of two different specimens; H-J, Female:- H, whole fly; I, abdominal tergite 6; J, tail end.

Diagnosis. Front basitarsus 0.82-0.85 times as long as tibia. With 9-12 axillary bristles. Wing with 10 axillary bristles and vein 3 with 2-3 dozen hairs.

Male. Figure 7A, head; Figures 7B-C, hypopygia of two different specimens; Figure 7D, front leg; Figure 7E, hind femur; Wing (Figure 7F) 2.3-2.4 mm long. Costal index 0.49-0.51. With 14-33 hairs on vein3 (Figures 7G & H) and 9-12 axillary bristles.

Female. Figure 7I, dorsal view; Figure 7J, tergite 6, Figure 7K, tail end.

Material examined. HOLOTYPE male, RUSSIA, Primorskiy Krai, Gornotayozhnoe, Mountain Taiga Station, 43°63'N, 132°25'E, 21-31.vii.2000, M. V. Michailovskaya (University of Cambridge Museum of Zoology). Paratypes, 1 male, 2 females, as Holotype.

Etymology. Named after the type locality Mountain Taiga Station.

Key to the males of the *Aenigmatiasdorni* species complex

Couplet 8 of the key to males (Disney, 2002) is rewritten thus:-

- 1 Ratio of length of front basitarsus to length tibia less than 0.7..... 2
- Ratio of the length of front basitarsus to length of tibia exceeds 0.7..... 3

2. The upper posterior lobe of the epaandrium typically gradually tapers to a rounded tip (e.g. Figures 4B&6B)..... 4 - Upper posterior lobe of the epaandrium more sharply tapered to a more pointed tip (Figures 3A&B)..... *A. lubbockii*

- 3 Axillary ridge with only 6-7 bristles..... 4
- With at least 9 axillary bristles..... 7

- 4 Ratio of length of front basitarsus to length of tibia less than 0.77..... 6
- This ratio more than this..... *A. gotoi*

- 5 Less than 15 hairs on vein 3..... 7
- More than 15 hairs on vein 3. (Epandrial lobes as Figure 4B)..... *A. marinae*

- 6 Upper epandrial lobe less tapered (Figure 5B). Costal index 0.50... *A. necdorni*
- This lobe more tapered (Figure 5H). Costal index 0.54-0.56..... *A. exregina*

- 7 Vein 3 with at most 28 hairs..... 8
- Vein 3 with at least 28 hairs. *taigaensis*

- 8 Vein 3 with at most 18 hairs..... *taigaensis*
- Vein 3 with at least 18 hairs..... *A. dorni*

***Megaseliamonochaeta* (Strobl) (Figure 8)**

Phoramonochaeta Strobl, 1892: 202.

This species is poorly known but was rescued from synonymy (Disney, 1999). A lectotype male (in the Naturhistorisches Museum, Admont, Austria) had previously been designated (Disney, 1983b). However, on remounting the syntype female on a slide it proved to be an entirely different species belonging to Schmitz & Beyer's (1965) Abteilung V, Zweite Reihe, but failing to run down in their key that is primarily based on males. However, it clearly does not belong to the *M. angustacomplex*.

The lectotype was from Austria. Published records from Italy and Spain evidently require confirmation. Indeed, specimens from Spain assigned to this species by Garcia-Romera & Barrientos (2014) correctly keyed their males to couplet 10 in my 1999 key, where the choice is between the longest hairs below the basal half of the hind femur are subequal in length to the maximum width of the hind tibia as opposed to being shorter. They opted for the first option. However, in a sample of their males kindly sent to me the hind femur hairs measure 0.06-0.07 mm compared with 0.08- 0.09 mm for the hind tibia width. Subsequent to my 1999 paper I wondered whether the internal subcutaneous pit sensilla (SPS vesicles) of the antennal postpedicel reported by Pfeil *et al.* (1994) might be a useful taxonomic character. This has proved to be the case. They are either present or absent and when present vary in

number and size. In the case of the lectotype of *M. monochaeta* it lacks SPS vesicles (Figure 8A). In the above specimens from Spain, assigned to this species by Garcia-Romera & Barrientos (2014), they are present in numbers (Fig. 8B) and this species proved to be *M. riefi* Brenner (2006), which is immediately distinguished by the SPS vesicles in its postpedicels (Figure 8B).

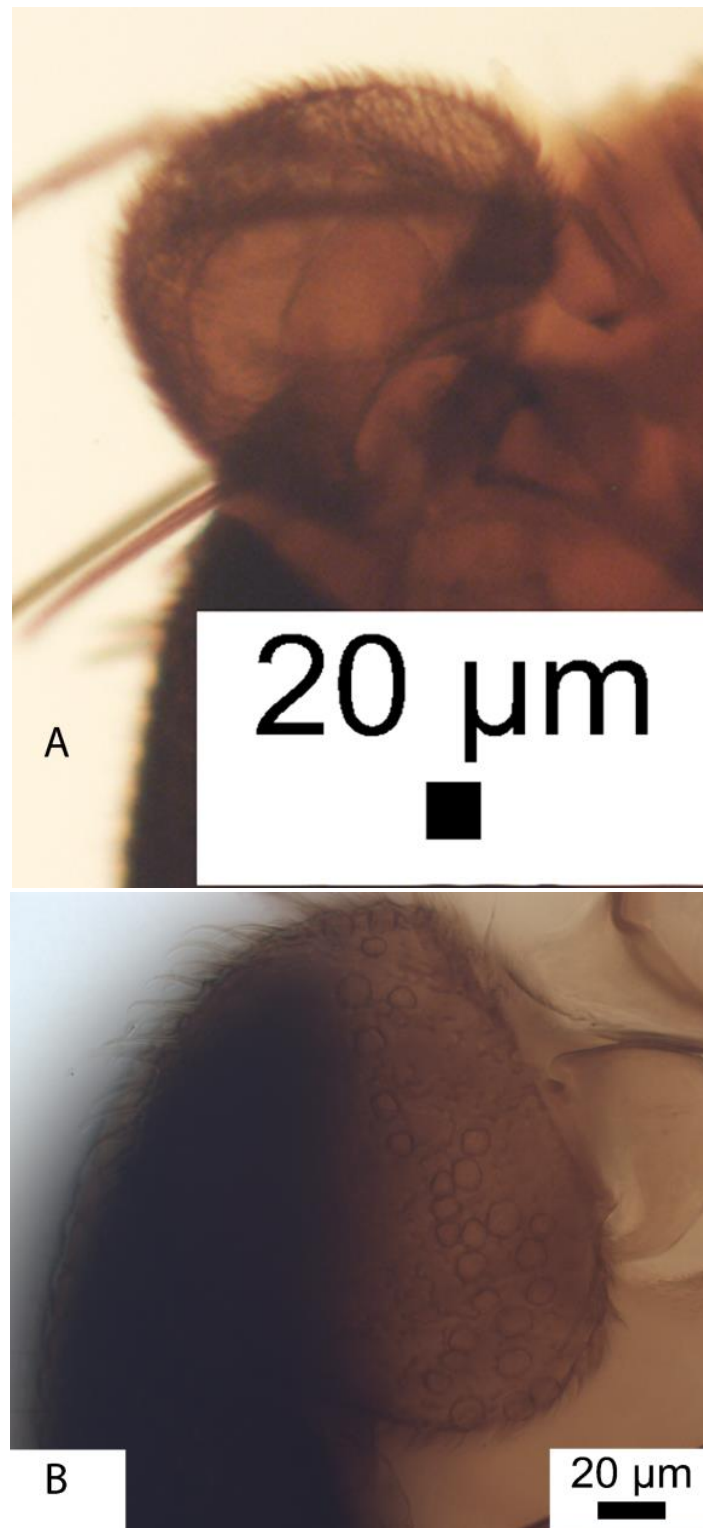


Figure 8 Postpedicels of *Megaselia monochaeta* and *M. riefi* males. A, *M. monochaeta*; B, *M. riefi*.

***Megaselia subnudipennis* (Schmitz)**

Aphiochaeta subnudipennis Schmitz, 1919: 117.

Megaselia quintincisa Disney, 2006: 88. Syn. nov.

In Beyer's (1965) keys to Afrotropical species most specimens run to the section on pages 56 and 57, covering species with a short costa. This omits species described by Collin (1912), does not allow for variation in the costal index and some couplets contrast males with females. Furthermore his '*M. punctata*' is a misidentification as it is not the same as *M. punctata* Bridarolli. As a result of these confusions I mistakenly described specimens from the United Arab Emirates as a new species. I now formally designate *M. quintincisa* as a synonym of *M. subnudipennis*.

***Megaseliaxanthozona* (Strobl)**

Phoraxanthozona Strobl, 1892: 203.

Megaseliaeuryprocta Schmitz, 1957: 234. Disney & Nussbaum, 1990: 112.

Megaseliaintrolapsa Schmitz, 1937: 121 (male). Syn. nov.

I have scrutinized the description and the keys of Schmitz (1958). His distinctions between *Megaseliaintrolapsa* Schmitz from *M. xanthozona* (Strobl) are poor and he omits reference to critical features of his species. I have therefore examined the following males attributed to Strobl's species: 5 from Spain, 2 from Yemen, 1 from Israel, 1 from Italy and 2 from Algeria. On the basis of these comparisons I here with synonymies *M. introlapsa* with *M. xanthozona*. More recent figures of *M. xanthozona* are provided in Disney (2009)

Acknowledgements

For the loan of specimens I am grateful to Dr Ximo Megual (Zoologisches Forschungsmuseum Alexander Koenig), Bonn - Schmitz Collection; to Dr Jenny Pohl (Museum für Naturkunde, Berlin) and Dr Milan Chavála (Naturhistorisches Museum, Admont, Austria - Strobl collection). My work on Phoridae is currently funded by the Balfour-Browne Trust (University of Cambridge).

Funding: This study has funded by the Balfour-Browne Trust (University of Cambridge).

Conflict of Interest: The authors declare that there are no conflicts of interests.

REFERENCE

1. Becker, T. *Psalidesman*. gen. Phoridarum. Wiener Entomologische Zeitung 2012, 31: 329-330
2. Beyer, E. M. Phoridae (Diptera Brachycera). *Exploration du Parc National Albert, Mission G. F. De Witte (1933-1935)* 1965, 99: 1-211.
3. Borgmeier, T. A catalogue of the Phoridae of the world (Diptera, Phoridae), *Studia Entomologica, Petropolis* 1968, 11: 1-367.
4. Brenner, S. Some new species of *Megaselia* Rondani (Diptera: Phoridae) from Austria (Nord-Tirol) and Italy (Süd-Tirol). *Entomologist's Gazette* 2006, 57:119-135.
5. Brown, B. V. Fossil evidence of social insect commensalism in the Phoridae (Insecta: Diptera) *Journal of Systematic Palaeontology* 2016, 15: 275-285. <http://dx.doi.org/10.1080/14772019.2016.1172676>
6. Chandler, P. (editor) Checklists of Insects of the British Isles (New Series). Part 1: Diptera. *Handbooks for the Identification of British Insects* 1998, 12:1-234.
7. Collin, J. E. Diptera. Phoridae from Seychelles. *Transactions of the Linnean Society of London* 1912, 15:105-118.
8. Disney, R. H. L., Scuttle Flies - Diptera, Phoridae (except *Megaselia*). *Handbooks for the Identification of British Insects*. 1983a, 10(6): 1-81.
9. Disney, R. H. L. A useful new character in the giant genus *Megaselia* (Diptera: Phoridae), with two new species from Britain. *Zeitschrift für angewandte Zoologie* 1983b, 70: 225-34.
10. Disney, R. H. L. A troublesome sibling species complex of scuttle flies (Diptera: Phoridae) revisited. *Journal of Natural History* 1999, 33: 1159-1216.
11. Disney, R. H. L. Revisionary notes and new key to *Aenigmatias* Meinert (Diptera, Phoridae). *Fragmenta faunistica* 2002, 45: 67-72.
12. Disney, R. H. L. Eight new species of *Megaselia* Rondani (Diptera: Phoridae) from the United Arab Emirates, Oman, and Yemen. *Zootaxa* 2006, 1371: 1-21.
13. Disney, R. H. L. Insects of Arabia scuttle flies (Diptera: Phoridae) Part II: the genus *Megaselia*. 2009, 249-357 in Krupp, F. (Editor-in-Chief) *Fauna of Arabia* 24. 405 pp. Senckenbergisch Naturforschende Gesellschaft, Frankfurt a.M, Germany and King Abdulaziz City for Science and Technology, Riyadh, Kingdom of Saudi Arabia. ISBN 978-3-929907-80-3.
14. Disney, R. H. L. 201x, A new species of *Aenigmatias* meinert (Diptera: Phoridae) from North America.
15. Disney, R. H. L. & Nussbaum, Y. Phoridae (Diptera) from Israel. *Israel Journal of Entomology* 1990, 24: 107-114.
16. Disney, R. H. L., Taylor, S. J., Slay, M. E. & Kreica, J. K.. New species of scuttle flies (Diptera: Phoridae) recorded from caves in Nevada, USA. *Subterranean Biology* 2011, 9: 73-84.

17. Enderlein, G. *Oniscomyiadorni*, eineneuedeutsche als Ameisengastlebendeflugellose Fliegengattung, sowieueber die systematische Stellungder *Thaumatoxena*. *Zoologisches Jahrbücher, Abteilungfür Systematik* 1908, 27: 145-156
18. Garcia Romera, C. & Barrientos, J. A. La fauna de Phoridae (Diptera) en el Parque Natural del Montsenyn (Cataluña, España). Citasnuevaspara la Penínsulalbéica. *Boletín de la Sociedad Entomológica Aragonesa (S.E.A.)* 2014, 54: 237–261.
19. Gotô, T. & Takeno, K. Discovery of the genus *Aenigmatias* Meinert from Japan, with are description of *A. Dorni* (Enderlein) (Diptera: Phoridae). *Esakia* 1983, 20: 139-148.
19. Jancík L. & Disney, R. H. L. A new species of *Aenigmatias* Meinert (Diptera: Phoridae) from Slovakia, whose larvae parasitise a queen ant (Hymenoptera: Formicidae). *Entomologist's Monthly Magazine* 201x, xx: x-x.
20. Meinert, F. *Aenigmatiasblattoides*, dipteronnovumapterum. *Entomologische Meddelelser* 1890, 2: 212-226.
21. Michailovskaya, M. V. *Scuttle Flies (Diptera, Phoridae) of the Far East of Russia*. Russian Academy of Sciences Far Eastern Branch. Vladivostok, Dalnauka. 2004a, 150 pp. [In Russian]
22. Michailovskaya, M. V. 31. Diptera. 60. Cem. Phoridae pp 9-40. In Key to the Insects of Russian Far East. Vol. VI. Diptera and Siphonaptera. Pt 3. Vladivostok, Dalnauka. 2004b, 659 pp. [In Russian]
23. Pfeil, R. M., Walsh, R. A. & Mumma, R.O. Scanning electron microscopic examination of the putative olfactory structures possessed by the phorid fly, *Megaseliahalterata* (Diptera, Phoridae). *Scanning Microscopy* 8, 687-94.
24. Schmitz, H. Die myrmecophilen Phoridender Wasmann'schen Sammlung. *Zoologischen Jahrbüchen. Abteilungfür Systematik, Geographie und BiologiederTiere* 1914, 37: 509-566.
25. Schmitz, H. Neueeuropäische *Aphiochaeta*-Arten II. *Entomologische Berichten. Nederlandseentomologische Vereniging* 1919, 5: 110-119.
26. Schmitz, H. *Revision derPhoriden*. 1929, Berlin: Ferd. Dummlers. 212 pp +Tafel I and II.
27. Schmitz, H. Spanische Phoriden des Madrider Museums. *Broteria* 1937, 33:119-127.
28. Schmitz, H. Spanische Phoriden des Madrider Museums. *Broteria* 1937, 33:119-127.
29. Schmitz, H. Phoridae. In: Lindner E (ed.), *Die Fliegenderpalaearktischen Region* 1941, 4(33) (Lieferung 141): 65-128. Stuttgart, E. Schweizerbart'sche Verlagsbuchhandlung.
30. Schmitz, H. Phoridae. In: Lindner E (ed.), *Die Fliegenderpalaearktischen Region* 1955, 4(33) (Lieferung 180): 321-368. Stuttgart, E. Schweizerbart'sche Verlagsbuchhandlung.
31. Schmitz, H. Phoridae. In: Lindner E (ed.), *Die Fliegenderpalaearktischen Region* 1956, 4(33) (Lieferung 187): 369-416. Stuttgart, E. Schweizerbart'sche Verlagsbuchhandlung.
32. Schmitz, H. Zoologisch-systematische Ergebnisseder Studienreise von H. Janetschek und W. Steiner in die spanische Sierra Nevada 1954. IV. Phoridae (Diptera). *Sitzungsberichter der Akademieder Wissenschaftenmathematisch-naturwissenschaftliche KlasseK1. Abt. I*, 1957, 166: 231-247.
33. Schmitz, H. Phoridae. In: Lindner E (ed.), *Die Fliegenderpalaearktischen Region* 1958, 4(33) (Lieferung 202): 465-512. Stuttgart, E. Schweizerbart'sche Verlagsbuchhandlung.
34. Schmitz, H. & Beyer, E. Phoridae. In: Lindner E (ed.), *Die Fliegender palaearktischen Region* 1965, 4(33)(Lieferung 258, 260): 513-608. Stuttgart, E. Schweizerbart'sche Verlagsbuchhandlung.
35. Strobl, G. Zur Kenntnis und Verbreitungder Phoriden Oesterreichs. *Wiener entomologische Zeitung* 1892, 11: 193-204.
36. Verrall, G. H. Description of a new genus and species of Phoridae parasitic on ants. *Journal of the Linnean Society of London* 1877, 13:258-260.