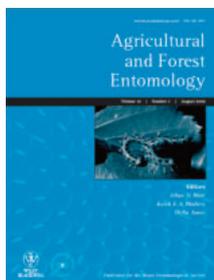


antenna

WEEVILS VS WATER WEEDS

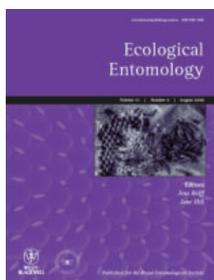
THINKING INSIDE THE BOX

Publications of the Royal Entomological Society



Agricultural and Forest Entomology provides a multi-disciplinary and international forum in which researchers can present their work on all aspects of agricultural and forest entomology to other researchers, policy makers and professionals. UK RES Members: £78

2016 print or online prices: UK £785, Euroland €999, USA \$1,451, Rest of World \$1,690
2016 print and online prices: UK £942, Euroland €1,199, USA \$1,742, Rest of World \$2,028



Ecological Entomology publishes top-quality original research on the ecology of terrestrial and aquatic insects and related invertebrate taxa. Our aim is to publish papers that will be of considerable interest to the wide community of ecologists. UK RES Members: £129

2016 print or online prices: (with Insect Conservation and Diversity) UK £1,301, Euroland €1,657, USA \$2,411, Rest of World \$2,812

2016 print and online prices: UK £1,562, Euroland €1,989, USA \$2,894, Rest of World \$3,375



Insect Conservation and Diversity explicitly associates the two concepts of insect diversity and insect conservation for the benefit of invertebrate conservation. The journal places an emphasis on wild arthropods and specific relations between arthropod conservation and diversity. UK RES Members: £78

2016 print or online prices: UK £795, Euroland €1,012, USA \$1,470, Rest of World \$1,712
2016 print and online prices: UK £954, Euroland €1,215, USA \$1,764, Rest of World \$2,055

Insect Molecular Biology has been dedicated to providing researchers with the opportunity to publish high quality original research on topics broadly related to insect molecular biology since 1992. *IMB* is particularly interested in publishing research in insect genomics/genes and proteomics/proteins. UK RES Members: £131

2016 print or online prices: UK £1,313, Euroland €1,667, USA \$2,426, Rest of World \$2,828

2016 print and online prices: UK £1,576, Euroland €2,001, USA \$2,912, Rest of World \$3,394



Medical and Veterinary Entomology is the leading periodical in its field. The Journal covers all aspects of the biology and control of insects, ticks, mites and other arthropods of medical and veterinary importance. UK RES members: £75

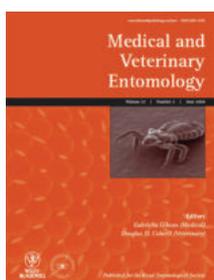
2016 print or online prices: UK £755, Euroland €962, USA \$1,398, Rest of World \$1,631

2016 print and online prices: UK £906, Euroland €1,155, USA \$1,678, Rest of World \$1,958

Physiological Entomology is designed primarily to serve the interests of experimentalists who work on the behaviour of insects and other arthropods. It thus has a bias towards physiological and experimental approaches, but retains the Royal Entomological Society's traditional interest in the general physiology of arthropods. UK RES Members: £70

2016 print or online prices: UK £697, Euroland €886, USA \$1,285, Rest of World \$1,500

2016 print and online prices: UK £837, Euroland €1,064, USA \$1,542, Rest of World \$1,800



Systematic Entomology encourages the submission of taxonomic papers that contain information of interest to a wider audience, e.g. papers bearing on the theoretical, genetic, agricultural, medical and biodiversity issues. Emphasis is also placed on the selection of comprehensive, revisionary or integrated systematics studies of broader biological or zoogeographical relevance. UK RES Members: £125

2016 print or online prices: UK £1,251, Euroland €1,592, USA \$2,314, Rest of World \$2,701

2016 print and online prices: UK £1,502, Euroland €1,911, USA \$2,777, Rest of World \$3,242

Subscriptions and correspondence concerning back numbers, off-prints and advertising for the seven principal journals of the Society should be sent to the publishers, Wiley-Blackwell Publishing Ltd, 9600 Garsington Road, Oxford OX4 2DQ. (customerservices@blackwellpublishing.com)



Antenna (Bulletin of the Society). Free to Members/Fellows. Published quarterly at an annual subscription rate of £50 (Europe), £55 (outside Europe), \$90 (United States). This journal contains entomological news, comments, reports, reviews and notice of forthcoming meetings and other events. While emphasising the Society's affairs, *Antenna* aims at providing entomologists in general with a forum for their views and news of what is going on in entomology. Subscriptions and advertising enquiries should be sent to the Business Manager at The Mansion House, Chiswell Green Lane, Chiswell Green, St. Albans, Hertfordshire AL2 3NS and any other enquiries to the Editors.

Handbooks for the Identification of British Insects. This series now covers many families of various Orders. Each Handbook includes illustrated keys, together with concise morphological, bionomic and distributional information. A full list of Handbooks with order form is available. See website www.royensoc.co.uk

Symposia. Nos. 1-3 were published by the Society; Nos. 4-10 by Blackwell Scientific Publications; Nos. 11-17 by Academic Press and No. 18 by Chapman & Hall, No. 19 by Kluwer, No. 20, 21, 22 and 23 by CABI.



CONTENTS

- 174** Editorial
- 175** Article – *Cyrtobagous salviniae* – Godsend in God's Own Country
- 178** Article – Musuem collections: a treasure trove for fungal hunters
- 181** Article – How many entomologists can you fit in a box?
- 185** Article – Natural History in the Black Country: Birmingham Museums Trust
- 196** Article – FSC Invertebrate Projects: the background and the progress
- 203** Society News
- 221** Book Reviews
- 224** Diary



COVER PICTURE

Examples of the Pratt family's South-East Asian Lepidoptera. See article on page 185: Natural History in the Black Country: Birmingham Museums Trust.

antenna

Bulletin of the Royal Entomological Society

The Royal Entomological Society
The Mansion House,
Chiswell Green Lane, Chiswell Green,
St. Albans, Hertfordshire AL2 3NS
E-mail: antenna@royensoc.co.uk

Editors:

Peter Smithers
(University of Plymouth)

and

David R. George
(Stockbridge Technology Centre)

Editorial Assistant:
Jennifer Banfield-Zanin

Consulting Editor:
Prof Jim Hardie

Assistant Editors:
Prof Adam Hart (Outreach)

Business Manager: Registrar

COPY DATES

For *Antenna* 40 (1) – 1st January 2016 (PS)

For *Antenna* 40 (2) – 1st April 2016 (DG)

Diary Copy date:

five days before *Antenna* copy date above.

Any facts or opinions expressed in this bulletin are the sole responsibility of the contributors. The Royal Entomological Society and the Editors cannot be held responsible for any injury or loss sustained in reliance thereon.

The Royal Entomological Society

The Mansion House, Chiswell Green Lane,
Chiswell Green, St. Albans, Hertfordshire AL2 3NS.
Tel: 01727 899387 • Fax: 01727 894797
E-mail: info@royensoc.co.uk

The Royal Entomological Society is a scientific society founded in 1833 and incorporated by Royal Charter in 1885 for the improvement and diffusion of entomological science exclusively.

Officers 2015/2016

President: Prof J. A. Pickett CBE (F)

Honorary Treasurer: Prof H. D. Loxdale MBE (F)

Honorary Secretary: Dr A. K. Murchie (F)

Honorary Editorial Officer: Prof L. M. Field (F)

Vice Presidents: Mr P. Smithers and Dr D. George

Members of Council:

Mrs J. P. North (F), Mr P. Smithers (Hon. F),
Mr C. P. Farrell (Hon. F), Dr D. R. George (F),
Dr J. A. Banfield-Zanin (F), Mr P. J. Willans,
Dr M. Cameron (F), Dr S. Beynon (F)
and Miss F. Sconce (M)

Chairs of Standing Committees:

Prof H. D. Loxdale MBE – *Finance Committee*

Dr A. K. Murchie – *Meetings Committee*

Prof L. M. Field – *Publications Committee*

Dr G. Port – *Membership Committee*

Prof J. A. Thomas OBE – *Insect Conservation*

Dr R. O. Clements – *Library Committee*

Dr L. A. N. Tilley – *Outreach and Development*

Registrar and Chief Executive:

Mr W.H.F. Blakemore E-mail: bill@royensoc.co.uk

Director of Science:

Prof R.J. Hardie E-mail: jim@royensoc.co.uk

Director of Outreach:

Dr L.A.N. Tilley E-mail: luke@royensoc.co.uk

Regional Honorary Secretaries:

Dr D. George (North), Dr J. Stockan (Scotland),

Mr P. Smithers (West), t.b.a. (East England),

Mr J. S. Badmin (South East),

Dr A. Murchie (Northern Ireland)

Library: Mrs Valerie McAtear, Librarian (lib@royensoc.co.uk)

The Library is open to Fellows and Members from 9.00am to 4.30pm Monday to Thursday and 9.00am to 3.30pm on Friday. The Library is not open on Saturdays and Sundays or public holidays, and such other times as may be notified in *Antenna*.

Subscription Rates 2016

The following are the subscription rates due on 1st March 2016: Fellows £54; Members £48; Students £25; Fellows and Members over 65 £32. The journals of the Society are available to individual Fellows and Members at preferential rates via the Subscriptions Department at The Mansion House. *Antenna* is supplied free of charge to Fellows and Members not in subscription arrears. **Cancellation of Journal subscriptions must be notified to Subscriptions Department before the 31st October in the year preceding cancellation.**

Printed by Andrew Smith Print Ltd
Chelmsford, Essex
email: andrew@asmithprint.co.uk

EDITORIAL



Hello and welcome to *Antenna* 39(4). As another year draws to a close, many of us will have already hung up our field equipment and outdoor entomological attire (in my case my wife's old festival hat and a rather fetching studded bum-bag kindly donated by a colleague). The winter ahead offers many of us the chance to catch-up on those indoor pursuits that never made the to-do-list when the days were longer and the insects active. I'm personally looking forward to a few months in the lab, interspersed with attempts to finally finish 'that paper', as well as 'that book' (or three) that I'm supposed to be reading; the eagle-eyed amongst you may have noticed my poor book review

record in comparison to that of my Co-Editor! For the collectors among us, the winter months afford the opportunity to organise and categorise while sampling nets lie in a similar state of torpor to many of their intended catches.

The content of insect collections, entomological and otherwise, is a theme that runs throughout this issue. In the first of three back-to-back articles on the subject, Roy *et al.* describe the value of museum insect collections to those with an interest in ectoparasitic fungi, specifically Laboulbeniales. Next, Pete Boardman provides a fascinating account of his personal quest to research the contents of a collection donated to the FSC. Pete's efforts here were directed not towards fungi, nor even primarily towards insects, but rather to the entomologists whose combined collecting efforts had happened into his care. No doubt many of us have amassed similar collections, though may never have asked the question "How many entomologists are in my box?". Should reading Pete's article inspire anyone to delve deeper into their own insect boxes, we'd love to hear from you. The final offering on collections in this issue is the next instalment from roving reporter Richard Kelly. Following a trip to the Black Country for his latest article, Richard reports on the value, albeit currently unrealised, of the entomological collections held by the Birmingham Museums Trust. Perhaps fittingly for an issue with a focus on collections and collectors, the final article of this issue, written by Rich Burkmar and Charlie Bell, describes the invaluable work of the FSC, past, present and future. I suspect that many an entomologist in many a box has at least an indirect link to the FSC in some shape or form. In their article on Classical Biological control, P. Sreerama Kumar and Abraham Verghese provide a break from the taxonomic trend. We begin this issue with their well written account on the use of the weevil *Cyrtobagous salviniae* to control the invasive water weed *Salvinia molesta*.

This issue also includes the usual Society News, with accounts of this year's Insect Festival and the next batch of RES Scholars. Prof Simon Leather has been in touch to let us know that the 2014-15 cohort of RES Scholars all passed their MSc, two with Distinction, one with Merit. Josh Jenkins Shaw has gone to the University of Copenhagen to do a taxonomically based PhD. Kelleigh Greene was the top student (and so will be awarded the RES MSc prize), and has started a job at Oxitec as a Research Assistant. Andrew Cutts passed with Merit and has set up an educational consultancy business (see <http://andrewcutts.com/>). As well as a number of book reviews (none of which, once again, were written by me), we also feature our regular Diary Section, with details of the 2016 Postgraduate Forum covered in more depth on the back cover. Those of you eager to hear more about the content, both scientific and dietary, delivered at Ento '15 in Dublin will need only to wait until the first issue of 2016.

We hope that you've enjoyed your *Antenna* throughout 2015 and wish you all happy holidays as we approach the festive season.

David George

Guidelines for submitting photographs

To maintain a high quality we suggest that submissions for *Antenna* be presented via e-mail or on CD. Files must be in a PC-compatible format preferably in MS Word.

Electronic images can be embedded in the Word document but we will also require separate electronic images. These images should be at least 300dpi at an image size that is either equal to, or greater than the expected final published size.

Please do not submit images that have been printed from a computer on a domestic inkjet or laser printer. Even if the camera is a good one and photo quality paper is used, the graininess is very hard to deal with. If plain paper is used, the prints are virtually unusable.

Photos taken on film should ideally be submitted as slides or as reasonable sized prints for us to scan or alternatively they can be scanned in by authors provided the scanner is capable of scanning at up to 1200dpi.

If an image is intended for the front cover then the photograph should be in portrait format (i.e. the shape of the final image) and will need to be quite a large file size (at least 5,000kb) or a good quality slide or print.

To give an idea as to what happens when the image is not of sufficient size, take a look at these two photographs. One is 300dpi and the other is 72dpi.



300dpi



72dpi



Fig. 1: A salvinia-free irrigation channel in Thrissur, Kerala (Photo: Abraham Verghese).

Cyrtobagous salviniae – Godsend in God’s Own Country

**P. Sreerama Kumar
& Abraham Verghese**

ICAR–National Bureau of Agricultural
Insect Resources
P.O. Box 2491
H.A. Farm Post
Hebbal
Bengaluru 560 024
India

psreeramakumar@yahoo.co.in
abraham.avergis@gmail.com

The successful biological control of the invasive *Salvinia molesta* D.S. Mitch. (Salviniaceae) by an exotic natural enemy in India is a story that needs to be highlighted to the world. Weed bioagents work so slowly that there is a tendency to give them up. The mitigation of the weed problem in the navigational waters of Kerala, a tourist destination popularly known as ‘God’s own country’, is an example of where patient waiting has paid off. In a span of 32 years, the weed has been “eaten” off the waterways to the extent of 95%. In surveys in 2014 and 2015, it was confirmed that the suppression of salvinia in Kerala was sustainable (Fig.

1) and one hopes that this remains so for a long time to come.

Originating in southeast Brazil, *S. molesta* has several names, but is commonly known as giant salvinia or water fern (Waterhouse and Norris, 1987). This perennial, free-floating aquatic plant is also infamously called the Kariba weed after its extensive infestation of Lake Kariba, the world’s largest man-made lake and reservoir along the Zambia–Zimbabwe border. The vegetatively reproducing (non-flowering) salvinia is a cause of concern in most regions outside its native range (Harley and Mitchell, 1981).



Fig. 2: *Cyratobagous salviniae* feeding on *Salvinia molesta* (Photos: J. Poorani)

Scientists still do not agree on how the weed found its way into India, but it was first sighted in the 1950s in Veli Lake, an inland waterbody separated from the Arabian Sea by a narrow sandbar, in Kerala's Thiruvananthapuram (then called Trivandrum). In 1964 — after more than a decade of its deemed existence in Kerala — it assumed pest status (Joy, 1978). This south Indian state is touted as 'God's own country' because of its pristine natural beauty and the sheer diversity of flora and fauna. In the local Malayalam language, salvinia is called African payal (meaning African moss).

Salvinia is capable of choking rivers, canals, lagoons and other water bodies. In Kerala especially, its infestation of waterways had a profound impact on navigation. Salvinia infestation on 75,000 acres of paddy in the 'rice bowl' Kuttanad area made cultivation pricey because of the labour-intensive clearing work before planting (Joy, 1978). It is also capable of reducing rice yields by competing for available nutrients (Singh, 1989).

Though searches for potential biocontrol agents began as early as in 1972 at the Kerala Agricultural University (Thrissur), researchers could not make headway with indigenous organisms (Joy, 1978). As a result, classical biological control (CBC) was first attempted with *Paulinia acuminata* (De Geer) (Orthoptera:

Pauliniidae), a grasshopper imported from Trinidad in 1974 through the Indian station of the Commonwealth Institute of Biological Control (CIBC). The insect failed to establish in the majority of release sites, and even in the few locations where it could establish there was unfortunately no population build-up (Joy *et al.*, 1981).

The second CBC attempt was after the formation of the All-India Coordinated Research Project on Biological Control of Crop Pests and Weeds. The Brazilian native *Cyratobagous salviniae* Calder & Sands (Coleoptera: Eirrhiniidae) (Fig. 2) was imported from Australia in 1982 (Jayanth, 1987) and its host-specificity was confirmed through tests with 75 plant species under 41 families (Jayanth and Nagarkatti, 1987). The dark brown *C. salviniae*, measuring about 2 mm, feeds on unopened leaf buds and internal tissues, and has a high rate of increase (Julien, 2012). Its efficacy was first demonstrated during 1983/84 in Bengaluru, where complete control of salvinia was achieved in a lily pond within 14 months (Jayanth, 1987).

The insect was supplied by the Indian Institute of Horticultural Research to Kerala Agricultural University for breeding and further releases in Kerala. As anticipated, it did not take long for *C. salviniae* to get established in Kerala. It dispersed

quickly and devoured the weed within two years of its first release, clearing over 1,000 square km of water bodies (Joy, 1986; Joy *et al.*, 1986). The insect population was augmented by the local agricultural university and the Kerala Department of Agriculture through distribution of boat-loads of infested salvinia mats.

Between 1980 and 2007, *C. salviniae* was introduced into 22 countries around the globe and in 17 its general impact has been significant (Winston *et al.*, 2014). Estimates in the 1970s indicated that salvinia had affected the daily life of about 5 million people in Kerala alone (Joy, 1978). The weevil worked wonders within no time from its first release. In Joy's (1986) words, "As a result the life in Kuttanad (boating, fishing, navigation and limeshell collection) is back to normal once again". In paddies, where Rs 250–750 had to be spent per hectare for manual removal, the savings on labour alone were estimated to be about Rs 6.8 million annually (Joy *et al.*, 1993). Though it is impossible to work out the accrued economic benefit of *C. salviniae* in the last three decades, the reappearance of water lily and lotus in water bodies that were once occupied only by salvinia is visual proof of biocontrol impact. This tiny weevil, first discovered by Wendy Forno of Australia (Julien, 2012), is indeed a godsend in God's own country!



References

- Harley, K.L.S. and Mitchell, D.S. (1981). The biology of Australian weeds. 6. *Salvinia molesta* D.S. Mitchell. *Journal of the Australian Institute of Agricultural Science* 47: 67–76.
- Jayanth, K.P. (1987). Biological control of the water fern *Salvinia molesta* infesting a lily pond in Bangalore (India) by *Cyrtobagous salviniae*. *Entomophaga* 32: 163–165.
- Jayanth, K.P. and Nagarkatti, S. (1987). Host-specificity of *Cyrtobagous salviniae* Calder and Sands (Col.: Curculionidae) introduced into India for the control of *Salvinia molesta*. *Entomon* 12: 1–6.
- Joy, P.J. (1978). Ecology and Control of *Salvinia* (African Payal) the Molesting Weed of Kerala. Technical Bulletin No. 2, Kerala Agricultural University, Trichur, India, 40 pp.
- Joy, P.J. (1986). *Salvinia* control in India. *Biocontrol News and Information* 7: 142.
- Joy, P.J., Satheesan, N.V., Lyla, K.R. and Joseph, D. (1986). Successful biological control of the floating weed *Salvinia molesta* Mitchell using the weevil *Cyrtobagous salviniae* Calder and Sands in Kerala (India), pp. 622–626. In: Noda, K. and Mercado, B.L. (eds) Proceedings of the Tenth Asian-Pacific Weed Science Society Conference, 24–30 November 1985, Chiang Mai, Thailand.
- Joy, P.J., Satheesan, N.V., Lyla, K.R. and Joseph, D. (1993). Biological control of aquatic weeds in Kuttanad. In: Proceedings of the National Symposium on Rice in Wetland Ecosystem, Kottayam, India, pp. 153–155.
- Joy, P.J., Varghese, K.C. and Abraham, C.C. (1981). Studies on biology and host range of *Paulinia acuminata* De Geer (Orthoptera: Acrididae) and its efficacy for the control of *Salvinia molesta* Mitchell - an aquatic floating weed in Kerala, pp. 201–206. In: Rao, B.V.V. (ed.). Proceedings of the Eighth Asian-Pacific Weed Science Society Conference, 22–29 November 1981, Bangalore, India.
- Julien, M.H. (2012). *Salvinia molesta* DS Mitchell – salvinia. In: Julien, M.H., McFadyen, R. and Cullen, J. (eds). *Biological Control of Weeds in Australia*, CSIRO, Australia, pp. 518–525.
- Singh, S.P. (1989). Biological Suppression of Weeds. Technical Bulletin No. 1, Biological Control Centre, National Centre for Integrated Pest Management, Bangalore, India, 27 pp.
- Waterhouse, D.F. and Norris, K.R. (1987). *Biological Control: Pacific Prospects*. Inkata Press, Melbourne, Australia, 454 pp.
- Winston, R.L., Schwarzländer, M., Hinz, H.L., Day, M.D., Cock, M.J.W. and Julien, M.H. (eds). (2014). *Biological Control of Weeds: A World Catalogue of Agents and Their Target Weeds*, 5th edition. USDA Forest Service, Forest Health Technology Enterprise Team, Morgantown, West Virginia, 838 pp.

Museum collections: a treasure trove for fungal hunters

The exquisite ectoparasitic Laboulbeniales (Ascomycota: Laboulbeniomycetes) are a group of fungi including about 2,100 species that infect a wide range of arthropod hosts – mostly true insects, but also mites and millipedes. The vast majority of species (80%) are found on beetles (Coleoptera). The total number of Laboulbeniales is estimated at 15-75,000 species (Weir & Hammond, 1997), most of which will be found in the tropical regions. These fungi do not produce a mycelium but individual fruiting bodies (or *thalli*) instead, which are easily observable (sometimes with a hand lens or even the naked eye). However, they often go unnoticed by entomologists and even mycologists rarely collect these fungi. So it is not surprising that we have limited understanding of the life histories of these amazing parasites.

Much – or maybe most – of our knowledge on Laboulbeniales comes

from an inspiring mycologist, Roland Thaxter (1858-1932), who dedicated much of his career to the study of this group. Thaxter described (and illustrated!) over 1,200 species of Laboulbeniales and his papers are amongst the best-cited ones in the field. There have been a scattering of additional, mostly taxonomy-focused manuscripts published over the years, but there are many unanswered questions and thus much to explore.

Large systematic collections of pinned insects are a treasure trove for these fungi. By 2014, DH screened over 30,000 insects at the American Museum of Natural History, the Harvard Museum of Comparative Zoology, and the Brabant Museum of Nature (Tilburg, the Netherlands) and found about 5.5% of these specimens to be infected with Laboulbeniales. Especially interesting are museum collections made in the context of an all-taxa biodiversity inventory, which

Katy Roy

D'Overbroeck's Sixth Form, Oxford, UK

Darren Mann

Oxford University Museum of
Natural History, Oxford, UK

Helen Roy

Centre for Ecology & Hydrology,
Oxfordshire, UK

Katie Murray

University of Stirling, Stirling, UK

Danny Haelewaters

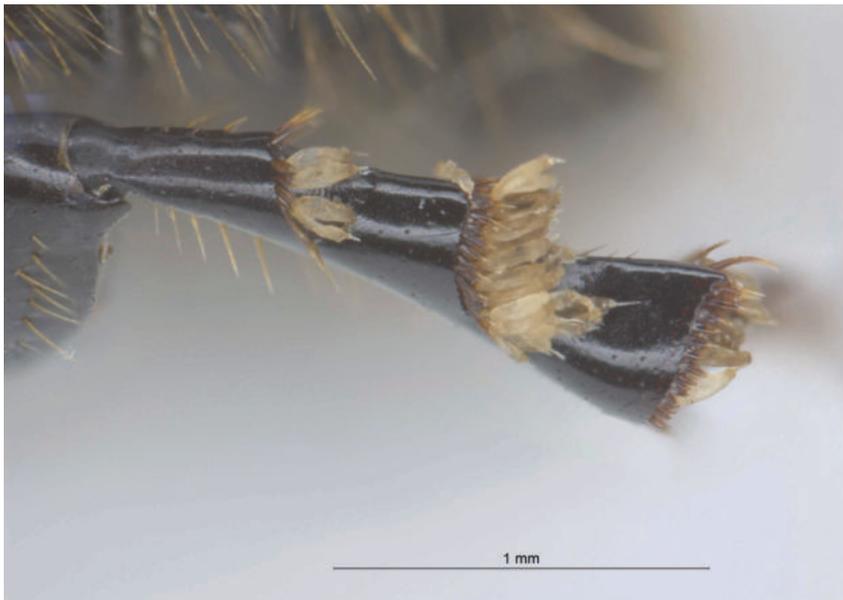
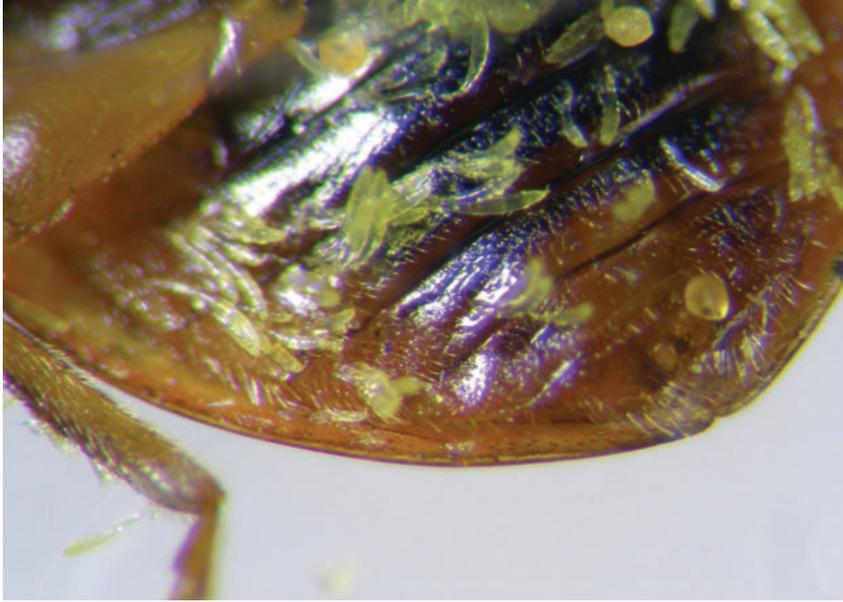
Harvard University, Cambridge,
Massachusetts, USA



Katy Roy hunting for Laboulbeniales in the Oxford University Natural History Museum.



Harmonia axyridis infected with *Hesperomyces virescens*.



Top: *Harmonia axyridis* infected with *Hesperomyces virescens* (underside); Bottom: *Aphodius pedellus*, with as yet unidentified Laboulbeniales *thalli* on hind tibia.

provides an excellent overview of parasite distribution and diversity (see Haelewaters *et al.*, 2015a,b).

Inspired by these museum collections and the research of DH, we began a collaborative initiative to search for these fungi on beetles at the Oxford University Museum of Natural History. Sixteen-year-old KR, under the supervision of DM (and with a little help from HR and DH), started screening the ground beetles (Carabidae) and has found a number of infected specimens. We know there are many more to find in this and other museums around the world. In addition, DM, enthused by KR and DH, has begun inspecting UK dung beetles (Scarabaeidae) from ongoing fieldwork for Laboulbeniales, with some success (see picture: *Aphodius pedellus*, hind tibia with Laboulbeniales *thalli*).

Meanwhile a lot of the attention of Laboulbeniales research has shifted to *Hesperomyces virescens*, a species that parasitizes several ladybird species

(Coleoptera: Coccinellidae) (Roy *et al.*, 2011). DH discovered that *H. virescens* is a cryptic species complex, with genetic lineages segregating by host species. KM found the parasite prevalence of *H. virescens* had dramatically increased in some London populations of the invasive *Harmonia axyridis*, from less than 1% in 2013 to 14% in 2014, confirming previous findings in Belgium, the Netherlands, and the USA. One of her PhD studies involves meticulous experiments on the interactions between this fungus and ladybirds, with a particular focus on impacts on host fitness. Last year KM launched an appeal inviting people to check ladybirds and record the presence of the fungus as part of the UK Ladybird Survey. It seems that *H. axyridis* has become the main host for this fungus in London (*sensu* De Kesel 2011), but the on-line survey will continue.

In our research we welcome the involvement of many people, including

volunteers and high school students. This group of tiny ectoparasitic fungi is uniting (citizen) scientists of all ages across the world. To date, the Laboulbeniales have always been enigmatic, pretty much unknown and mostly unstudied. Advances in molecular technology and international collaborations provide us with a unique opportunity to unravel some of the mysteries within this group.

Acknowledgements

KR and HR are extremely grateful to the Life Collections, Oxford University Museum of Natural History, which is incredibly welcoming and provides an inspiring environment for all. DH wishes to thank Lee H. Herman, Brian D. Farrell, and Paul van Wielink, respective curators at the American Museum of Natural History (Invertebrate Zoology), the Harvard Museum of Comparative Zoology (Entomology), and the Brabant Museum of Nature (Tilburg, the Netherlands).

References

- De Kesel A. 2011. *Hesperomyces* (Laboulbeniales) and coccinellid hosts. *Sterbeeckia* 30: 32-37.
- Haelewaters D., De Kock G. and van Wielink P. 2015a. Nieuwe Laboulbeniales in De Kaaistoep. *Natuurstudie in De Kaaistoep. Verslag 2014, 20e onderzoeksjaar*: 11-18.
- Haelewaters D., Zhao S.Y., De Kesel A., Handlin R.E., Royer I.R., Farrell B.D. and Pfister D.H. 2015b. Laboulbeniales (Ascomycota) of the Boston Harbor Islands I: species parasitizing Coccinellidae and Staphylinidae, with comments on typification. *Northeast. Nat.* 22: 459-477.
- Roy H.E., Rhule E., Harding S., Lawson Handley L.-J., Poland R.L., Riddick E.W. and Steenberg T. 2011. Living with the enemy: parasites and pathogens of the ladybird *Harmonia axyridis*. *BioControl* 56: 663-679.
- Weir A. and Hammond P.M. 1997. Laboulbeniales on beetles: host utilization patterns and species richness of the parasites. *Biodivers. Conserv.* 6: 701-719.



How many entomologists can you fit in a box?

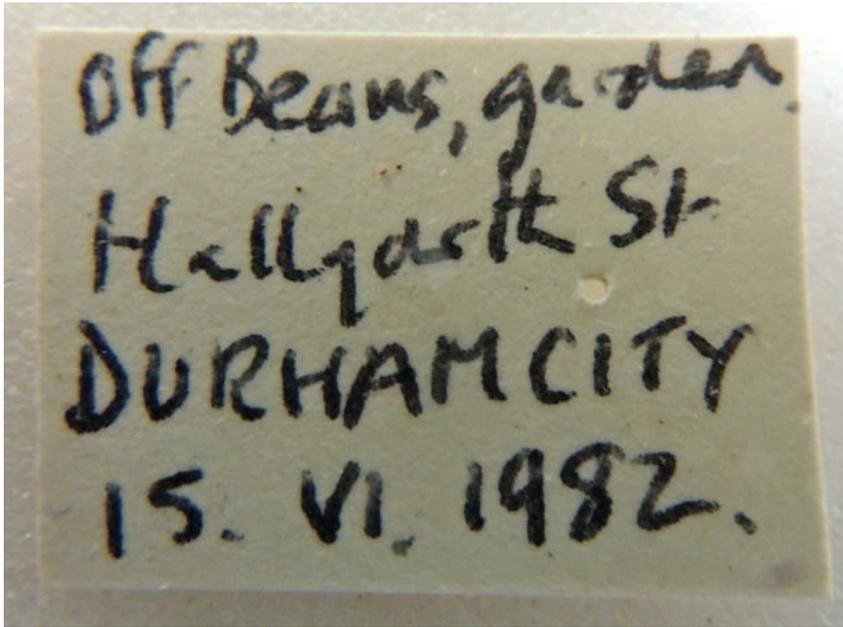
Pete Boardman

[This article is based upon a talk I delivered at Shropshire Entomology Day in 2013 and is reproduced here thanks to prompting from Prof. Simon Leather.]

At some point in 2012, during my employment with the Field Studies Council, I received a couple of large cardboard boxes containing various store boxes of insect samples. These had been donated to the organisation with the specific requirement that they be used in education, but nobody really knew what to do with them and so they ended up with me, at the time the only entomologist in the organisation. Upon examination there were thousands of samples of the same blow fly species, and smaller amounts of more varied material; a few beetles, an odd looking weevil, some Hemiptera, one or two Odonata, a few solitary bees, a spectacular Death's Head Hawk Moth *Acherontia atropos* (Linnaeus, 1758), but mostly flies with the families Calliphoridae and Simuliidae key amongst them. Some boxes were very much worse for wear; others had

been attacked by pests, so I decanted a selection of the best material into a brand new store box. This would become a regular companion during the next two years as I visited various groups of people to spread the entomological gospel. Curiosity dictated that I should interrogate the specimen labels (where they existed) and it became apparent that there was a story to tell about the boxes, the insects within them, the entomologists who collected and once owned them, and the transposition of all these entomologists into my new store box. How many entomologists *can* you fit in a box?

The material had been donated by the family of the late Lewis Davies (1924-2006) who I confess I had not heard of when I started this quest. A bit of internet research quickly pointed me in the direction of an obituary in the



Davies' own hand

British Simulid Bulletin (2007), written by Roger Crosskey and contributed to by others, that shed light upon a remarkable entomological career and started to reveal clues to the evidence before me. Davies was born in North Wales and was awarded a first class degree in zoology from Bangor University in 1945. He went to Durham University as a research assistant in 1947 and later became a lecturer there. His debut publication was the rather wonderfully titled 'Sweating in Sheep' which was

published in Nature during 1947. As Crosskey wrote "In the pre-1950 years, Lewis's research was devoted to the immature stages of calliphorids, especially those of *Lucilia sericata* responsible for 'blowfly strike' of sheep, and his Ph.D. - awarded to him by Durham in 1949 - was on these flies." All those thousands of blowflies in his collection were starting to make sense, though they did include a couple of exotic outliers; a specimen of *Chrysomya albiceps* Robineau-Desvoidy, 1830 collected by G.F. (Gerald Freer) Hill (1880-1954) in

Townsville, North Queensland, Australia in March 1921 (which came via the Liverpool School of Tropical Medicine) and a specimen of the same species collected from Quetta, India by Charles George Nurse (1862-1933), the British soldier who made great strides in Indian entomology, dated August 1902. Rather interestingly GBIF (www.gbif.org) does not show this species with an Australian distribution.

Crosskey continues "Lewis's entry into blackfly research arose from a specific event. In 1950 he participated in the Durham University Zoological Expedition to Norway, a "magnificent country" which instantly captivated him." This explained the prominence for blackflies from within the collection. Clearly there had been some sharing of material involved as there were blackflies collected by some legendary entomological names including: a specimen collected by the father of British Nematoceran study, Fred. W. Edwards (1888-1940), which was collected from Laerdal, Norway in July 1923 (species without det label), *Austrosimulium* (*Austrosimulium*) *australense* (Schiner, 1868) collected from Auckland, New Zealand in February 1923 by Andre Tonnoir (1885-1940), specimens of two species collected from Carabis Bay, Cornwall by Alfred Thornley (1855-1947) which were both determined by Henri Audcent (1875-1951), an unnamed specimen taken by F.C. Adams (unknown birth year -1919) from the New Forest in 1898, an unnamed specimen collected on Box Hill by Norman Riley (1890-1979) (elected President of the RES in 1952), an unnamed specimen collected by Leonard Coe (R.L. Coe) (1906-1968) from Loch Morlich, Inverness in 1933, and one of Roger Crosskey's specimens bred from a puparium collected at Druidale, Isle of Man in August 1962. Incidentally, Andre Tonnoir met his untimely demise whilst out collecting in the field. Having failed to return to his office a search was launched and he was found lay beneath a tree in an orchard, presumably having stopped for a rest. If we all have to depart this life at some point then departing it on a field collecting trip seems as good a way as any.

Davies left Durham in 1957 for what proved to be a relatively short spell with



HS Robinson's weevil



Death's-head Hawkmoth.

the Canadian Department of Agriculture. He returned in 1960 to Durham where he became a Senior Lecturer in 1961 and published the Freshwater Biological Association Key to Blackflies. He then embarked on what became an obsessional relationship with the blackfly *Crozetia crozetensis* (Womersely, 1937), an endemic species to the Possession Islands in the South Atlantic, some 2,000 miles from the nearest land mass. Davies was convinced this was a key

species in understanding the evolution of blackflies and travelled there in 1968, 1972-73, & 1978-79. I won't expand on this part of his life here as it has no relevance to the collected material in my store box, but I would urge readers to seek out his aforementioned obituary (a link is in the References of this article) and revel in the photograph of Davies with his French colleagues taken in 1968 (Possession was home only to thirty French research scientists who "spoke no more English than the word 'Ok'") and imagine how wonderfully the isolated evenings were spent! Sadly there were no specimens of *Crozetia crozetensis* in the material I received but research revealed that some material from his expeditions to the Possession Islands, including specimens of *Crozetia*, are held in the collection of the University of Alberta. Some years later a review of his material was undertaken by Craig, Currie & Vernon (2003) who discovered the vast majority of his specimens were actually *Crozetia seguyi* (Beaucournu-Saguez & Vernon, 1990). This is a good example of how entomology continues to evolve and move on with new techniques for study and dissemination, and new generations examining the work that has gone before. Hopefully this will always be the case.

this weevil was here at all is not so much of a surprise as Crosskey states that on the 1971/2 expedition to the Possession Islands Davies spent much of his time looking at weevils and beetles. Instead it was the location of the specimen, Fiji, and the collector (H.S) Hugh Robinson (1907-1986) that caused some surprise. Robinson, of the eponymously named moth trap, is another interesting figure. A wonderful piece from the New Scientist in 1974 describes the advent (20 years earlier) of the mercury vapour trap when "H.S. Robinson momentarily blinded a room full of entomologists from a chair no less august than that of the president of the Royal Society when he publicly demonstrated the hyper-attractive powers of the mercury vapour light, sometimes reckoned the collector's H-bomb". Robinson worked for the Colonial Civil Service and was posted to Kuala Lumpur, Malaysia, and then to Fiji. So there was a link to the Fiji weevil, but why did Davies have it in his collection? This only became clear when I read the obituary of Robinson's son, Gaden (1949-2009) (Beccaloni et al., 2009), who it appears studied under Davies at Durham and was awarded his PhD in 1974. Gaden spent a year in Fiji studying Lepidoptera so presumably had brought specimens of his own and his father's back to the UK to study. So the weevil specimen had passed from father to son and on to an interested third party, Lewis Davies. Now it sits in my specimen box



Hill's calliphorid

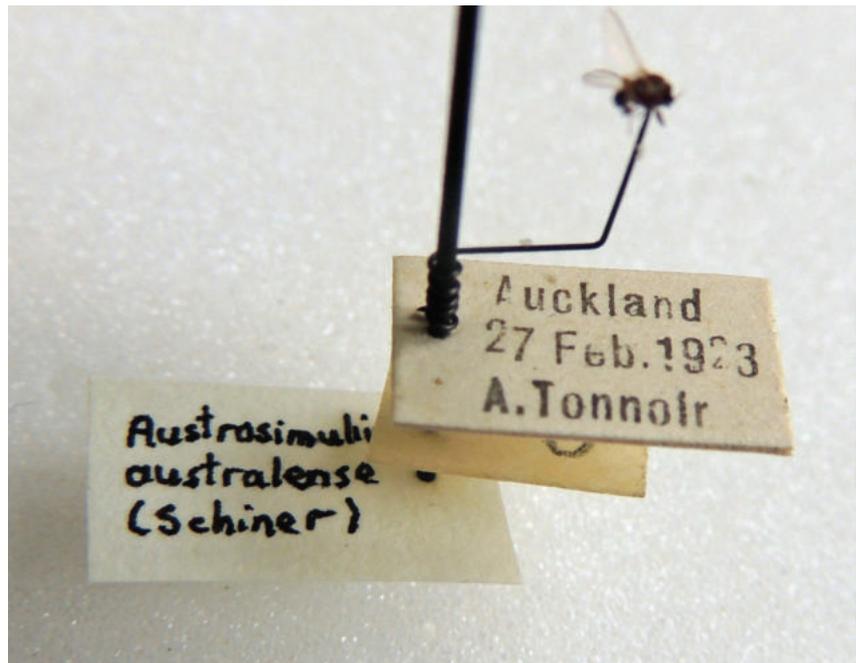
Many of the more modern specimens in the collection appear to reflect Davies' fieldwork locally to his Durham home (including an unidentified Stalk fly taken off his runner beans in his Durham garden) and regionally with several specimens from well known North Yorkshire sites including Askham Bog. There are a couple of Dolichopodidae specimens collected by Davies and identified by C. E. "Peter" Dyte (1930-2012), several muscid flies collected by Davies and determined by Adrian Pont, and a ground beetle determined by Martin Luff. The most recent specimens amongst the collection are from the early to mid 1990's, though Davies continued to publish on blowflies up to the year of his death in 2006.

So this story weaves its way through several continents, many species of insect, and some legendary names in the world of entomology. It enables the connection of a new generation to the life of a man who was at the forefront of research into Diptera. Many of these facets, these echoes of lives, would have been totally lost to me (and everyone else) had not the store boxes arrived at our door. How many stories like this one never get to be told due to the family members of entomologists not recognising the worth in what they might see as useless boxes of dead insects? How many of these boxes have found their way into the anonymity of landfill as a result?

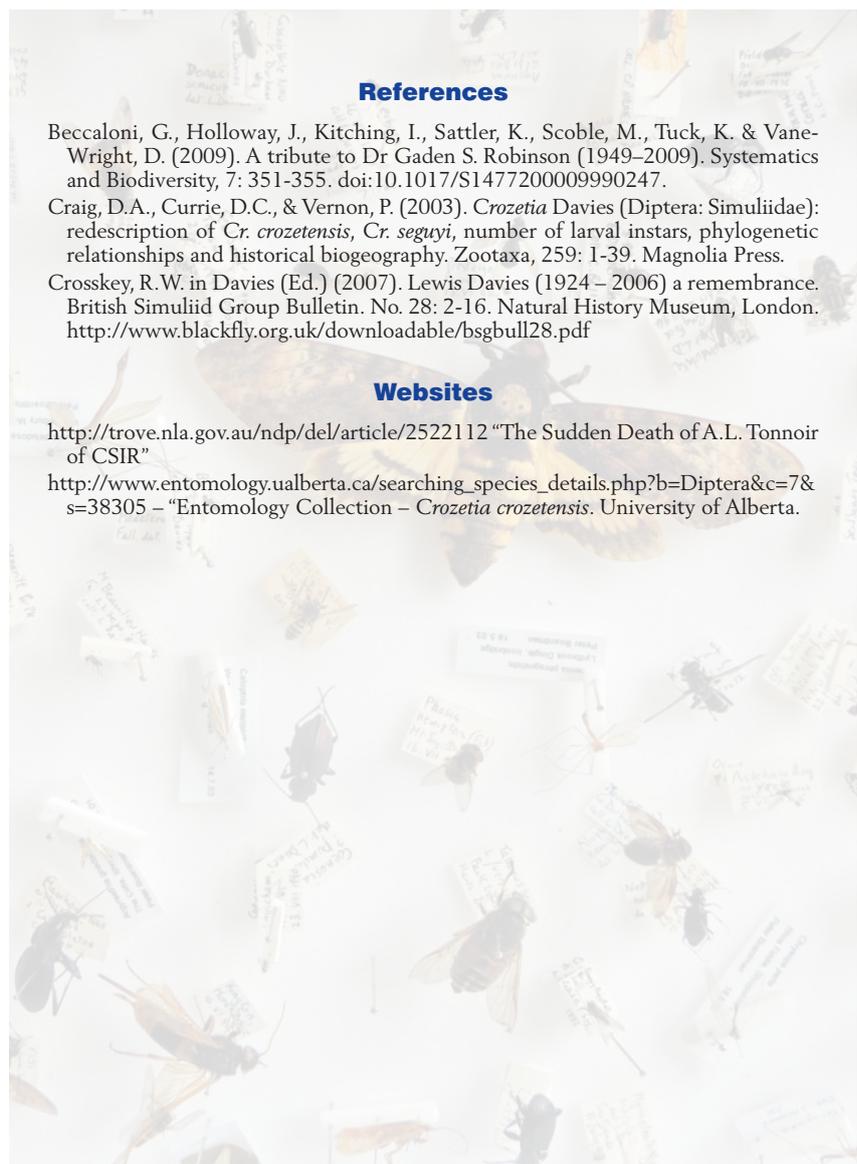
I leave this story with half glimpses of Nurse's India, Robertson's Fiji, the tree under which Tonnoir died, the blinding light at the Royal Society, and all the insects in the box. The strongest image I have, however, is the one in Davies' obituary of him photographed at his old desk at the Canadian Department of Agriculture in Ottawa on a return visit in 1999; an old man looking back over his shoulder who, though I obviously never met him, through these stories I feel I knew just a little.

Acknowledgements

The author would like to thank Simon Leather for suggesting this subject should receive a wider audience, Valerie McAtear in the Royal Entomological Society Library, Sue Townsend at the Field Studies Council, and the family of Lewis Davies.



Tonnoir's black fly



References

- Beccaloni, G., Holloway, J., Kitching, I., Sattler, K., Scoble, M., Tuck, K. & Vane-Wright, D. (2009). A tribute to Dr Gaden S. Robinson (1949–2009). *Systematics and Biodiversity*, 7: 351-355. doi:10.1017/S147200009990247.
- Craig, D.A., Currie, D.C., & Vernon, P. (2003). *Crozetia* Davies (Diptera: Simuliidae): redescription of *Cr. crozetensis*, *Cr. seguyi*, number of larval instars, phylogenetic relationships and historical biogeography. *Zootaxa*, 259: 1-39. Magnolia Press.
- Crosskey, R.W. in Davies (Ed.) (2007). Lewis Davies (1924 – 2006) a remembrance. *British Simuliid Group Bulletin*. No. 28: 2-16. Natural History Museum, London. <http://www.blackfly.org.uk/downloadable/bsgbull28.pdf>

Websites

- <http://trove.nla.gov.au/ndp/del/article/2522112> "The Sudden Death of A.L. Tonnoir of CSIR"
- http://www.entomology.ualberta.ca/searching_species_details.php?b=Diptera&c=7&s=38305 – "Entomology Collection – *Crozetia crozetensis*. University of Alberta.



Natural History in the Black Country: Birmingham Museums Trust

In this series discussing insect collections around the country we have already visited several museums, each taking a different approach to collection care and exhibition. It is starting to seem as though each museum has its own distinct way of managing the information it collects. In this instalment we see yet another style of collection management where we encounter a great collection with significant research potential, but which has had limited opportunity for public exhibition. Speaking with

Luanne Meehitiya, the natural history curator for Birmingham Museums, I find out that Birmingham has been calling out for a dedicated natural history museum for over a century. However, it seemed to miss the golden era of Victorian naturalism when most of the country's natural history museums were established and since then the dream has never been realised. Today we see a collection with excellent representation of local, national and international flora and fauna, but without the museum in

Richard Kelly

richard.kelly.nh@gmail.com
@Worldwide_Richi



Tree of life
All of life connects in a giant family

Life in the water

Escape predators from land and air
Travel with the currents
Move without legs but with fins and flippers
Enjoy food abundance

Figure 1. A tree of life showing the diversity and interconnectedness of species.

which to express the collection to the public.

As we saw with Bristol Museum & Art Gallery in the previous article there are inherent difficulties in museums that share facilities with art galleries. There seems to be a struggle between the arts and the sciences and we often find natural sciences left behind. Birmingham's museums were recently transferred from local government to trust management, which brought together all of Birmingham's heritage sites into an organisation dedicated to both science and the arts. Luanne tells me that since this change there has been a much bigger push to explore and exhibit the natural science collections. Nevertheless, to date there are still no natural sciences on display in the city's main Museum & Art Gallery and they are restricted to a compact gallery in the city's science museum Thinktank. Luanne is keen to see the development of the collection as a research asset and to further integrate natural history into the larger Birmingham Museums for greater visibility of the collections.

History of natural history in Birmingham

Birmingham was one of the first cities in England to take up manufacturing as a full time job and reaped the rewards

during the industrial revolution and into the decades following. The city's prosperity survived the WW2 bombings and the city was extensively redeveloped in the 1960-70s. Birmingham is still the second largest economy in the UK and as such it has an education and heritage sector to match. Its eight universities make it the second biggest higher education sector outside of London and the Birmingham Museums Trust runs nine museum sites throughout the city, making it the largest independent charitable trust of museums in the UK. The one thing Birmingham doesn't have, that many other cities do, is a dedicated natural history museum to exhibit its fantastic zoological, botanical and palaeontological collections. As I learn from Luanne, this is not for want of trying.

Luanne explains that Birmingham somehow missed the golden age of Victorian naturalism and so a museum of natural history was never set up as it was in many other cities around the country. The city still enjoyed an active community of natural history enthusiasts meeting under names such as the Birmingham Natural History and Philosophy Society (1894-1963). In the late 19th century there were calls from the people of the city to build a natural history museum and, given the wealth

and skills present in the city at the time, it would have been a museum to rival any other in the country. In 1914 a natural history exhibition was established as part of the art gallery with big plans for the future of natural history in the city. Then WW1 commenced and resources were redirected to the war effort, putting a lot of plans on hold. Following WW2 Birmingham's money and energy were put into the much needed redevelopment of parts of the city that had been destroyed and although there were still calls for a natural history museum, the resources were not available to build one. Even up to a few decades ago there were calls to release funds for a new museum, but recession and funding crises prevented, and continue to prevent, this vision being realised.

Since the move to the Birmingham Museums Trust in 2010 there is renewed hope for natural history in the UK's second city. The trust is a combined arts and science organisation and is working on realising the potential of not only the city's fantastic art collections, but also its forgotten natural history collections. Luanne tells me that the dream of a dedicated natural history museum is probably still out of grasp, but the incorporation of the natural sciences into Birmingham Museums is happening and the

collections are becoming more accessible both for research purposes and public exhibition.

Collections on Display

Thinktank is Birmingham's science museum and interactive centre and the site of the only exhibition on natural sciences in the city. The display takes an interesting but compact whistle stop tour through the life sciences and touches on a number of key areas. The displays are small and there is little information compared to that found in a dedicated natural history museum. Proportionally, however, there seems to be a lot more information on insects; perhaps they are easier to display in the space due to their smaller size.

Walking past the extinct giant deer (*Megaloceros giganteus*) at the entrance to the exhibition we come to a Tree of Life which takes the visitor on a short tour through the diversity of life. Rather than phylogenetic accuracy the design seems to lean toward encapsulating the web like nature of the 'tree of life' and the fact that there is no clear progression through evolution. Pleasingly to the entomological eye, there are two types of insect represented, a dragonfly and a swallowtail butterfly (fig. 1).

Moving round we then come to a display which is very fitting for the city. The Black Country apparently got its name due to high levels of pollution during the industrial revolution which quite literally turned their countryside black. Tree trunks were covered in black soot which is thought to have led to the adaptive evolution of the peppered moth (*Biston betularia*) (Tutt, 1896), a model system taught in almost all high school biology classes. This classic study looks at what is known as 'industrial melanism', a process which sees the moths adapt from a light grey peppered with black to a melanistic form, protecting them from predation. It is an interesting and interactive display, asking the visitor to spot the different colour moths on tree trunks (fig. 2), but there is little information to explain the process behind the moths colouration. This could be a great place to introduce people to the concepts of adaptive selection, and to predator-prey interactions, and if the natural sciences were given a greater space to work with I'm sure it would



Figure 2. The peppered moth in the Black Country.

be.

A display called "Who's at home in your house?" is next which takes a look at commensal insects living in our houses, such as the clothes moth, daddy long legs, vine weevils and blowflies. Again this is a nice introduction, but there isn't space to display any actual specimens. There are plenty of examples of insects and other animals in the stored collection which could be displayed here. To the side of this display there are a couple of others which are again mostly about insects. There is a small section introducing the concept of breeding strategies, telling the visitor about owl butterflies laying hundreds of eggs so that at least a few will survive. Lastly the visitor is introduced to the concept of the difficulties faced by animals that live in seasonal habitats with a display called "Migrate or hibernate?" This shows a number of examples of butterflies that use either of these strategies to survive.

Leaving the natural sciences section there is a rather stunning case used for the purpose of showing off some of the animal kingdom's diversity. Again there is a surprisingly large number of insects displayed. As is often the case Lepidoptera are the most abundant specimens on display (fig. 3), but there are also some of the larger representatives of Coleoptera (fig. 4) and Orthoptera (fig.5). All in all it is a really pleasant exhibition space. A wealth of basic information on different scientific theories and studies is present, but, as earlier, there just isn't the space to go into enough detail. Hopefully this will change over the coming years and we'll see more of the museum's stored collections on display for the public to interact with.

Behind the scenes

The collections at the Birmingham Museum stores hold approximately 250,000 natural history specimens from across the breadth of zoology,



Figure 3. Some examples of the Lepidoptera on display



Figure 4. *Goliathus* sp. which represent some of the largest insects alive today.

local importance and provides a key dataset of the changes in the local environment over the collection period. Over half of these specimens, approximately 150,000, are entomological with broad taxonomic coverage of the orders Lepidoptera and Coleoptera, a reasonable amount of Hemiptera (fig. 6), Diptera and Hymenoptera and several representatives of Odonata, Orthoptera (fig. 7) and Phasmatodea (fig. 8).

Luanne began her curatorship at the museum several years ago. Prior to this there hadn't been a natural history curator at Birmingham Museums for most of the past few decades and Luanne has worked hard over the past few years to bring the potential of the collections to light. Along with several volunteers Luanne has carried out a survey of the insect collections and has marked each drawer with a number representing its research potential based on quality of specimens and availability of data. The vast majority of the specimens are stored by collector, as we saw previously at the Cole Museum and at Bristol Museum & Art Gallery, but there has been some effort to begin to arrange the specimens taxonomically. Although I would usually agree that arranging specimens taxonomically is more useful from a research perspective, some of the collections only really retain all of their original information, and indeed their beauty, in their original format.

Local collectors

G.B. Manly

Mr. Manly was a local collector and breeder of mainly Lepidoptera and his collections (fig. 9) are a good example of the information that can be retained by leaving collections as they were donated. He was a prolific collector in his time and his collections have directly benefitted our knowledge of British Lepidoptera (for example: Hammond & Smith, 1955). He was also a regular contributor to the Entomologists Record and Journal of Variation (Manly, 1995), describing scenes from which he had collected his insects. You can see in Figure 9 the effort he put into preserving not only the specimens but also their life history and the circumstance in which he collected them.



Figure 5. Some examples of Orthoptera on display.



Figure 6. Hemiptera are mostly represented by a few stunning cicada specimens (Cicadoidea).



Figure 7. A katydid which uses leaf mimicry to avoid predation (Tettigoniidae).

Stuart Carlier

The Carlier collection holds thousands of Microlepidoptera and Coleoptera specimens collected from the local area in the early 20th century. As part of Birmingham Museum Trust's attempt to shed some more light on the natural science collections, this collection became the museum's 'object of the month' and the focus of an article in the Birmingham Post (Barnfield, 2015). Carlier was very prolific in the local natural history scene and as well as lecturing in entomology at Birmingham University he was the secretary of the Birmingham Natural History and Philosophy Society between 1937 and 1962. There are numerous examples of Staphylinidae (fig. 10), Cerambycidae (fig. 11) and many others. Carlier was meticulous when it came to collecting and recorded scrupulous detail about each of his collecting trips, including information on collection methods and weather. Part of the Carlier collection includes moth caterpillars beautifully blown by H.E. Hammond (fig. 12). This method was detailed by Hammond in a book published by the Amateur Entomologists' Society (Hammond, 1948).

Other collections

In the other collections held at the museum the Lepidoptera are the best represented, with collections of British moths and butterflies by Richard South (fig. 13) and Sir Arthur Scott; Southeast Asian butterflies by Major Richard Dyott and the Pratt family (fig. 14); and European varieties by Mr. Stopher. The South collection was used in the publication of a book on British moths (South, 1933) directly increasing our knowledge of national species. The Coleoptera are also well represented with an interesting tropical collection from Lowe Thompson which attracted the attentions of the NHM and led to the arrangement of a placement exchange with Dr. Michael Geisner, a coleopterist from London who managed to do a lot of work arranging the previously disparate collection. Lowe Thompson also collected a variety of other orders (figs. 6, 7, 8 & 15). There is an extensive collection of Coleoptera collected by the Rev. Henry Gorham which is on long term loan to the university and which are



Figure 8. Phasmatodea: A leaf insect which also uses mimicry (Phylliidae).



Figure 9. Mr. Manly's collection of mostly Lepidoptera including the stunning white-barred clearwing moth *Synanthedon speciformis* (inset).



Figure 10. Carlier's Staphylinidae collection.



Figure 11. Carlier's Cerambycidae collection.

used in the training of undergraduate and postgraduate students. Gorham published extensively on coleopteran taxonomy and ecology (for example: Gorham, 1887; 1894; 1900) and his collections have contributed to others (for example: Rafkind, 1993).

There are several smaller collections of note including a nice collection of British Diptera collected by R.C. Bradley (fig. 16) and a collection of

Hymenoptera: Apidae collected by D. Allen (fig. 17). Bradley's Diptera were included in a report of dipteran biodiversity in the Staffordshire area (Emley, 1992).

Palaeoentomology

The entire geology collection of Birmingham Museums is on long term loan to the Lapworth Museum at the

University of Birmingham and unfortunately I wasn't able to arrange a visit to see it in person. The curator did tell me that the strengths of the collection lie in quaternary Coleoptera, collected mostly by the late Professor Coope. They also have a few Jurassic beetle elytra and a dipteran specimen of Purbeck age.

Research potential

The importance of the museum's collections to the development of knowledge, not only at the local level, but also at national and international level, is evident. During our talk Luanne stresses the importance of developing and researching local collections as well as the larger national collections. Local collections in cities outside London are often overlooked and so can provide a relatively untapped source of data for investigating environmental and biodiversity changes over time. Luanne is a big supporter of big data and believes that the collections at Birmingham will allow researchers to investigate the changes in biodiversity, and therefore environmental perturbation, on a fine local scale. She is understandably keen to advocate the collections for research along these lines.

Luanne has begun building links with local and national research organisations including Birmingham's universities, national natural history societies (including the Dipterists Forum) and other museums such as NHM. The hope is that these connections will prompt researchers to take an interest in the collections at Birmingham and to realise their research potential. Luanne is also keen to begin active collecting again and explains that active collecting has largely fallen away in recent decades. There is still some way to go before collecting is up to Victorian standards, but Luanne is interested in gathering volunteers and students from the university to get involved. Many of the visitors to the collections have been artists or art students, interacting with the beauty and symbolism of insects for purely aesthetic purposes (see Box 1 for supplementary information on 'Insects in art').



Figure 12. The life cycle of the Death Sphinx (*Acherontia Atropos*) beautifully preserved by Hammond.

Insects in art

Insects have been a part of our everyday life for as long as we humans have existed and this has been captured through artistic expression for millennia. Some of the first known pieces of art, created 8,000 years ago, depicted people interacting with honey bees (Dicke, 2000). Dicke carried out a survey of Western Art and delves into the use of insects for aesthetics and for symbolism through the ages. The Ancient Greeks regularly incorporated insects into their spiritual art and saw the process of metamorphosis in Lepidoptera as a symbol of the soul leaving the body. The Greek word for butterfly "Psyche" is also the Greek word for soul. This is a notion that has permeated into later Western cultures with images from 13th century Venice depicting the soul as being a human form with butterfly wings. In 15th century continental European paintings, a fly is often depicted on a portrait to indicate that the person had died. The papers of Marcel Dicke on this subject are a fascinating read, taking an entomological view of the history of art (Dicke, 2000; Dicke, 2004).

In conclusion the natural history collections at Birmingham Museum have, in the past, been important for developing our knowledge of both local and national species. In the past few decades, however, the collection has mostly passed into obscurity, being largely forgotten about in a museum devoted to the arts. The move from local government to trust management over the past few years has seen an increased interest in developing the collection for both research purposes and public engagement. Luanne is keen to increase the visibility of the collections and to work on releasing its research potential. She is therefore keen for anyone interested to get in touch and to feel welcome to visit the collections.

Next on the agenda for our tour is the Yorkshire Museum at the invitation of the curator. The collections here are known for their national and international importance and cover four main areas: biology, geology, astronomy and archaeology. If you are a curator of a natural history collection in the UK that you believe to be of entomological importance then please get in touch and we can arrange a visit to cover your collection in a future article.

References

- Barnfield, S. (2015). Beetle mania... Birmingham's amazing insect collection is latest Museums Trust 'object of the month'. URL: <http://www.birminghampost.co.uk/business/creative/beetle-mania-birminghams-amazing-insect-9624535>.
- Dicke, M. (2000). Insects in Western art. *American Entomologist* **46**, 228-237.
- Dicke, M. (2004). From Venice to Fabre, insects in Western art. *Proceedings of the Netherlands Entomological Society* **15**, 9-14.
- Emley, D.W. (1992). *Staffordshire Flies: A provisional list*. Staffordshire Biological Recording Scheme Publication No. 15.
- Gorham, H.S. (1887). On the Classification of the Coleoptera of the Subfamily Languriidae. *Proceedings of the Zoological Society of London*, 358-362.
- Gorham, H.S. (1894). On the Coccinellidae from India in the collection of Mr. HE Andrewes of the Indian Forestry Service. *Annales de la Société Entomologique de Belgique* **38**.
- Gorham, H.S. (1900). Descriptions of new genera and species of Coleoptera from South and West Africa, of the section Serricornia and of the families Erotylidae, Endomychidae, and Languriidae. *Journal of Natural History* **5**, 71-94.
- Hammond, H.E. (1948). *Preserving caterpillars: how to "blow" and "pickle" larvae successfully*. London: Amateur Entomologists' Society.
- Hammond, H.E. & Smith, K.G.V. (1955). On some parasitic Diptera and Hymenoptera bred from lepidopterous hosts. Part 2: misc. records of Phoridae, Larvaevoridae (Dipt.), Braconidae, Ichneumonidae and Eulophidae (Hym.). *Entomologist's Gazette* **6**, 168-174.
- Manly, G.B. (1951). various notes. *Entomologist Record and Journal of Variation*, pp 119, 174, 179.
- Rifkind, J. (1993). A new species of Cymatoderella Barr (Coleoptera: Cleridae) from Mexico and Central America, with a key and distributional data for the genus. *The Coleopterists' Bulletin*, 279-284.
- South, R. (1933). *The Moths of the British Isles*. London: Frederick Warne.
- Tutt, J. W. (1896). *British Moths*. London: George Routledge.



Figure 13. Examples of South's British Lepidoptera (a: *Catocala fraxini* b: *Plusia* sp.).

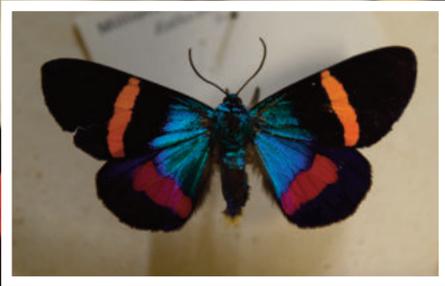


Figure 14. Examples of the Pratt family's South-East Asian Lepidoptera.



Figure 15. Damselflies collected by Lowe Thompson.



Figure 16. R.C. Bradley's collection of British Diptera: Larvaevoridae.

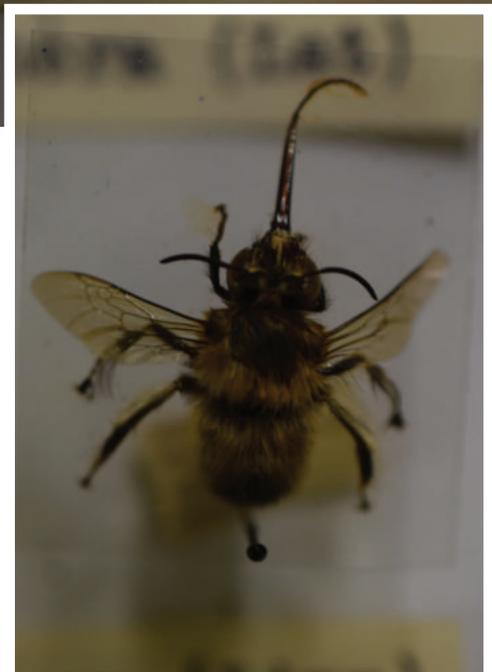
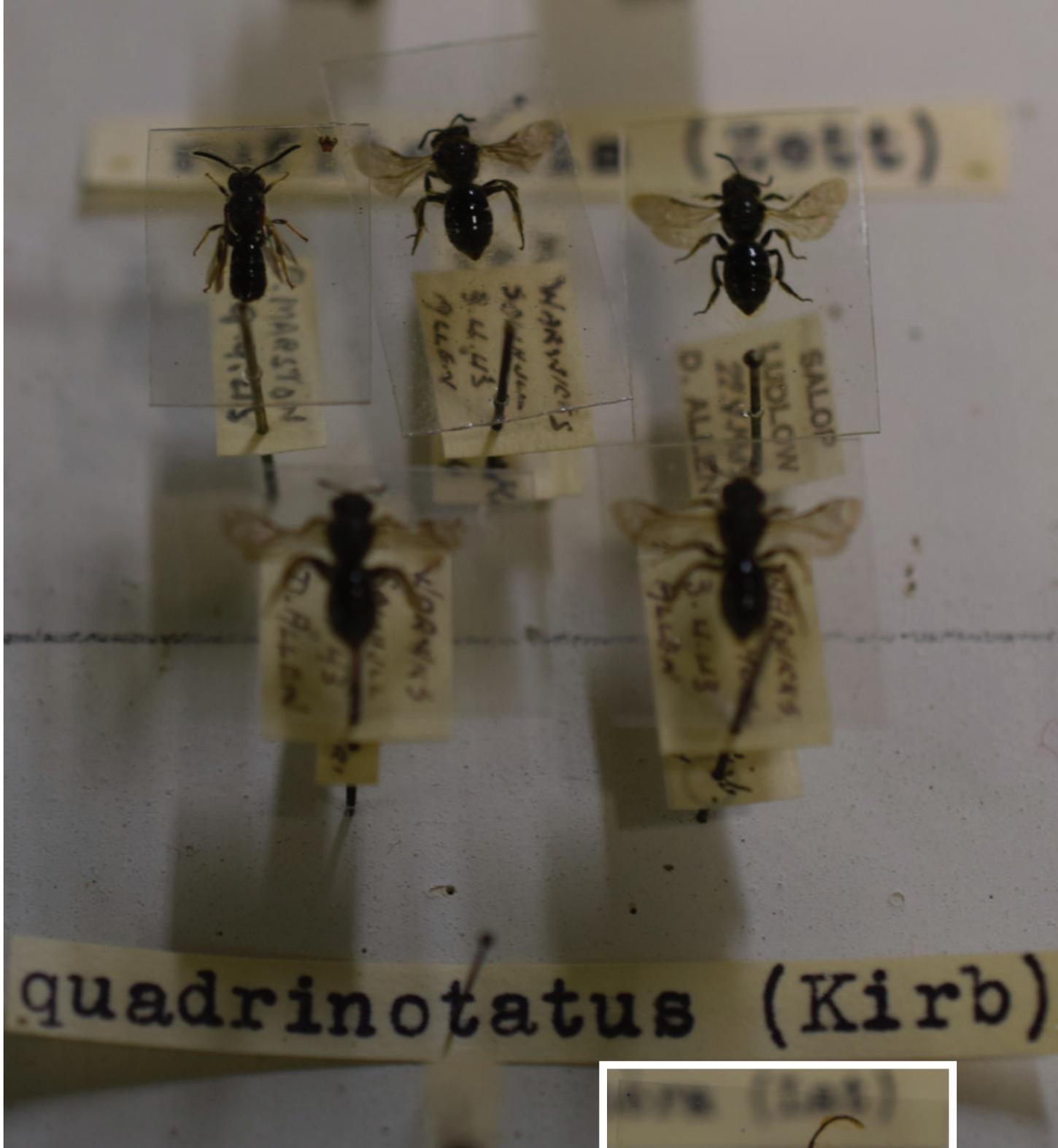


Figure 17. D. Allen's collection of Hymenoptera: Apidae including specimens from the Birmingham area, Lancashire and



FSC Invertebrate Projects: the background and the progress

Natural history education – a changing landscape

The Field Studies Council (FSC) has been associated with high-quality education in field ecology and natural history since its foundation in 1943. Many expert amateur natural historians, as well as those eminent in the academic and professional realms, can point to an early experience with FSC that was instrumental in setting the course of their personal journeys. Adult education has always been an important element in FSC's work, but the bulk of the people coming through FSC's doors are young people, including GCSE and A level students and university undergraduates, paid for by their institutions.

The largest income stream for this not-for-profit charity is course fees from customer groups in formal education; mostly schools, colleges and universities. This income has enabled FSC to keep going, despite some very challenging periods over the last 70 years, and reach the point where it maintains 19 field centres (15 of them residential) staffed by over 470 people including tutors, administrators, managers, caterers and housekeepers. (This figure does not include Associate Tutors – see below.) The needs of school and university customers must remain at the forefront of FSC's business strategy if it is to survive into the 21st century.

Rich Burkmar & Charlie Bell

A consequence of the focus on school and university groups is that forces influencing what universities and schools teach also have a profound effect on the shape of FSC. Over the past three decades or so there has been a contraction of field-skills on the syllabuses of biological degrees and a loss of opportunities for field-based education on increasingly rigid national curricula. An upshot for FSC is that avenues to teach natural history field-skills to young people are harder to find. This is inevitably reflected in the skills of the educational staff recruited by the organisation over recent decades, not only because of the shift in syllabuses away from natural history, but also because of the increasing difficulty of finding new tutors with these skills. This is not just a problem for FSC of course, it is mirrored across the entire sector.

One of the strengths of FSC's adult natural history education - by which we mean the biological identification and field ecology courses normally attended by independent adult customers - is that they are usually taught by FSC Associate Tutors; that is tutors who are not FSC employees but independent experts in their own fields. FSC has 188 Associate Tutors on its books. This partnership model has helped buffer FSC's adult natural history offering against the effects of the dilution in natural history skills.

Nevertheless, a successful FSC natural history course requires not only an expert Associate Tutor, but also interested and knowledgeable FSC staff to facilitate the course. These FSC staff help the Associate Tutor to prepare the course, arrange and maintain suitable equipment (e.g. microscopes), keep an eye open for potential field sites, and so on and so forth. Without this kind of in-house knowledge and expertise, successful natural history courses would be much harder to stage. So to maintain the highest standards in its natural history courses, FSC needs to buck the national trend and increase the levels of natural history skills within the organisation.

The FSC response

In response to the problems outlined above FSC created the new organisation-wide role of Biodiversity Learning Manager in 2011, based at



The current FSC Biodiversity Team. From left to right: Rich Burkmar, Robin Sutton, Charlie Bell and Sue Townsend; inset: From the FSC staff conference in 1962. These FSC 'wardens', as they were then called, were all highly motivated and experienced natural historians. From left to right: John Sankey, Charles Sinker, Ian Mercer, Jim Bingley, John Barrett, Paul Holmes, Geoffrey Hutchings.

FSC Head Office (within the grounds of the FSC Preston Montford field centre in Shropshire). The first and present holder of this post is Sue Townsend who was previously Head of Centre at Preston Montford for some 18 years. Preston Montford, perhaps above all other FSC field centres, has a tradition of natural history education which Sue strengthened during her tenure, for example by starting the accredited post-graduate programmes in biological recording in association with Sarah Whild (formerly of University of Birmingham and now of Manchester Metropolitan University) which are highly-regarded within the sector.

Over the last few years Sue has gathered a small team around her. The work of the central FSC Biodiversity Team splits into three main areas:

- increasing the capacity of FSC's in-house expertise in natural history;
- hosting biodiversity projects to increase the range of FSC's adult natural history provision and

explore ways of teaching natural history skills more effectively; and

- working in partnership to deliver biodiversity education projects hosted by other organisations.

As well as managing the entire team, Sue has been responsible for bringing in the external funding upon which all of the biodiversity education projects described in this article have depended. To this end she has been supported by FSC's National Grants Officer, Jennie Comerford, who provides the specialist skills required to draw together effective funding applications. Another major facet of Sue's role is to work closely with partner organisations to deliver biodiversity projects hosted by them. A recent example of this is the Identification Trainers for the Future project which is hosted by the Natural History Museum and closely supported by FSC, for example by the provision of placements for the trainees within the education teams at several FSC residential field centres.

Robin Sutton - an FSC tutor of some 30 years' experience - is the member of the team responsible for upskilling FSC's own tutors in natural history. Robin is one of a number of experienced FSC tutors that remain highly-skilled and motivated naturalists. In the 18 months since he joined the Biodiversity Team he has put a number of initiatives in place aimed at motivating FSC tutors and providing them with opportunities to improve their own natural history and field ecology skills as well as tools and techniques for inspiring and teaching the students that come through their field centres.

The FSC Biodiversity Team's biodiversity education projects, aimed at adult learners, include a strong element of natural history training. These courses run independently of FSC's wider portfolio of 'traditional' natural history courses, but our aim is to both complement and inform that portfolio. Our biodiversity education projects are described in the remainder of this article. We touch upon all of the projects run by the FSC Biodiversity Team, but concentrate on those with the most invertebrate interest.

Past invertebrate projects

The FSC Biodiversity Team's strong reputation for biological identification training, particularly for more difficult groups including invertebrates, has its roots in a series of projects managed between 2006 and 2014 by Pete Boardman. The first of these was a Heritage Lottery Fund (HLF) project called the Biodiversity Training Project (2006-2010 inclusive). Although this was aimed mainly at engaging new naturalists and biological recorders - many without any previous experience of natural history - it also touched on some of the more popular invertebrate groups such as dragonflies and damselflies. One effect of this Shropshire-based project, sustained over a five year period, was that it built up a considerable local audience, many of whom were ready to take things to the next level by the end of it. The next project managed by Pete - Invertebrate Challenge - gave them a vehicle to do just that.

Invertebrate Challenge was funded by HLF and Esmée Fairbairn (2011-2014 inclusive) and, as the name suggests, was aimed squarely at



Pete Boardman's discovery of *Bilobella braunerae* in his Shropshire garden in 2015, determined by Peter Shaw, is the first record for this species in this country. Surely one of the most photogenic springtails!

providing training, resources and support for recording invertebrates, particularly the more challenging groups of invertebrates. Like the Biodiversity Training Project its audience was drawn mostly from Shropshire and the surrounding area. But in contrast to the Biodiversity Training Project, with its wide scope and comparatively low-level training, Invertebrate Challenge, with its much narrower focus and higher-level training, targeted a much smaller audience. The result was a very strong group of highly-motivated individuals, many of whom transformed their biological identification skills, as well as participation in the biological recording network over the course of the project. One astonishing statistic is that this project helped create 10 new invertebrate county recorders for Shropshire, including those for Araneae, Collembola, Orthoptera, Coleoptera, Diptera (several groups), Odonata, Lepidoptera (micro-moths), terrestrial Hemiptera (two recorders) and aquatic Hemiptera.

Invertebrate Challenge was originally intended to be a three year project. In

the event it stretched over four years to accommodate another project, Biodiversity Fellows, in 2013. This one-year project funded by Defra (through Natural England) aimed to boost biological recording for many under-recorded taxa including bryophytes, fungi, lichens and many of the "less charismatic" invertebrate groups. In an astonishing effort, Pete organised over 70 training courses delivered in 2013 at FSC field centres and other locations up and down the country.

With the conclusion of the Invertebrate Challenge project at the end of 2014, and with no successor project in place, Pete's contract with FSC ended, underlining a real weakness with the model of working towards long-term goals through a succession of time-bound externally-funded projects. Although sorely missed by the FSC Biodiversity Team, Pete's skills and experience with invertebrate identification and training are not lost to the wider community, especially since he takes up a new permanent role with Natural England in 2016 as an invertebrate specialist in their new Field Unit.

Tomorrow's Biodiversity overview

Tomorrow's Biodiversity ('Tom.bio') is an FSC project funded by the Esmée Fairbairn Foundation for five years (2013-2017 inclusive). It is helping us to identify important gaps in identification and monitoring skills, as well as barriers to filling those gaps, and developing/trialling solutions with new training, resources (e.g. new AIDGAP keys or electronic resources) or other interventions.

The first two years (2013-2014) focused on finding the gaps and barriers and framing the delivery phase. The delivery phase (2015-2017 inclusive) is developing 'exemplar' projects which can address some of the gaps and trial new ways of working that can overcome some of the barriers. The project will enable FSC to develop new resources and training for taxa and/or habitats that are currently under-resourced, but which have the potential to make a valuable contribution to our understanding of how biodiversity fares over the coming decades in the face of rapid environmental change. It's no surprise that many of the taxa that we identified as subjects for the delivery phase are invertebrates.

The project is managed by Rich Burkmar with the help of Charlie Bell who joined on a part-time basis at the start of the delivery phase in 2015. The scope of the delivery phase is wide and includes such diverse elements as the use of new data visualisation technology for exploring taxonomic knowledge-bases, GIS training for biological recorders, support for the new National Plant Monitoring Scheme, new identification resources, and more. (For more details on these see our website at tombio.uk.) In the remainder of the article we describe three Tom.bio projects which focus on training in identification, recording and monitoring skills for three invertebrate groups: spiders, soil mesofauna and earthworms.

The Shropshire Spider Project

The Shropshire Spider Group (SSG) was born of FSC Invertebrate Challenge. Over the course of that project, Nigel Cane-Honeysett developed a mere interest in spiders into a high level of technical ability as



Cucumber Spider *Araniella cucurbitina* female guarding egg cocoon, Whixall Moss NNR ©John Bebbington FRPS

a spider recorder; so much so that he took on the role of Shropshire County Recorder for spiders and harvestmen for the British Arachnological Society. Despite Nigel's skill and enthusiasm, the SSG itself remained a very small group with only a handful of active participants.

Rich Burkmar is also a spider recorder of considerable experience and together with Nigel Cane-Honeysett identified an opportunity to strengthen and enlarge the SSG by providing intensive training and support to this local recording group through the Tom.bio project. We are particularly interested in trialling, for the three-year delivery phase, an integrated training programme that offers something for everyone, from those with the earliest glimmerings of interest right through to those who are already very experienced – something which we visualise as a 'pyramid of engagement'.

Despite the small number of active recorders in the SSG, local interest in spiders is healthy. We piloted some 'beginners' training in 2014 before the commencement of the Tom.bio delivery phase and found that demand for places outstripped initial capacity. We eventually ran three beginners courses in 2014 with 42 people attending. At the time of writing in 2015, we have delivered a further beginners' course (13 attendees) and have another planned for later in the year.

A clear message from the Tom.bio project consultation phase was that identification courses for difficult

taxonomic groups that are billed as suitable for beginners were often 'too hard' and disappoint many participants. So we are very careful about how we pitch our beginners' courses for spider identification. They are more accurately characterised as courses for 'field identification and recording'. They do not include microscope work or collecting specimens for preservation; we concentrate on identifying live spiders (and harvestmen), both in the field and in the classroom, with the use of a hand-lens and a 'spi-pot' (a device for restraining a live spider for close examination). We are careful to point out the limitations of identification and recording in this way, but we also underline the real value of those records of live spiders which can be identified to species as well as the value of identifying taxa at levels above species such as genus or family.

The beginners' courses have been very well-received, but we also discerned an audience for which even this kind of course is 'too hard'. So earlier in 2015 we trialled a 'pre-beginners' course which we billed as a 'learn to love spiders' day. This was almost entirely classroom based and really aimed to enthuse people about spiders as a fascinating group of animals. For the most part we steered clear of the subject of recording. Identification, where we touched on it, was couched in terms of 'telling apart' the most commonly encountered spiders. We believe that we engaged an audience (8 attendees) through this course that would



Tomoceros minor identifiable by the tridentate spines on the furca.



Collecting springtails on the 2015 Soil Mesofauna course. Matthew Shepherd is in the centre with Pete Boardman immediately to the left of him and Peter Shaw immediately to the right.

So far in 2015 we have run one 'intermediate' level course (in association with the Severn Gorge Countryside Trust) where we concentrate on microscopic identification of preserved specimens (5 attendees) and we have another planned for later this year. We have also organised an 'expert-level' workshop –

aimed primarily at the more established members of SSG – where an external expert (Richard Gallon) is going to cover specialist techniques for spider identification such as clearing specimens. As we go further up the 'pyramid of engagement' (i.e. towards courses suitable for those with more experience) the potential audience for

them dramatically decreases which brings its own challenges in terms of making them economically viable. In 2016 and 2017 we want to be smarter about joining the different courses up and moving people from one level to the next up the pyramid – this is the real challenge of the Shropshire Spider Project and the particular nut we are trying to crack with it.

The Soil Mesofauna Project

During the Tom.bio consultation phase a number of groups were identified as being significantly under-recorded yet extremely ecologically and/or economically important. Soil mesofauna, defined loosely as soil invertebrates ranging in size from those just visible to the naked eye up to a few millimetres, were one such group. Major components of soil mesofauna are soil mites and springtails - it is these two groups which are the particular focus of this project.

The Soil Mesofauna project could not have been developed without the support and enthusiasm of several dedicated people. The project incorporates an annual four-day Soil Mesofauna course and the story of how this came about is a great illustration of the value of the large network of naturalists and organisations which the FSC brings together, supports and benefits from. The need for a specialist Springtail ID course was first raised by a student on the Biological Recording Masters programme run by Manchester Metropolitan University in conjunction with the FSC. This idea was championed by Peter Shaw of Roehampton University, who had been mentored by the late Steve Hopkins, the national springtail recorder and the author of the FSC key to Collembola. Around the same time Natural England were looking for opportunities to provide training for their volunteers in Soil Mesofauna monitoring. So the remit of the course was expanded to cover Soil Mesofauna in general, including soil mites, and the four day course was born. This course first ran in 2011, tutored by Peter Shaw and David Harding, an expert on soil mites who sadly passed away earlier this year.

Supporting this first course, and learning much from it themselves, were three people who have since become key to the continuation of the Soil

Mesofauna course - Matthew Shepherd, Felicity Crotty and Pete Boardman. Matthew Shepherd is now Natural England's senior soil scientist; Felicity Crotty is an expert in soil mites; and Pete Boardman is fast becoming an expert on Shropshire's springtails. These three people, alongside Peter Shaw, have delivered the training on the four subsequent Soil Mesofauna courses. Tom.bio became involved in this course in 2014, financially supporting its delivery, hosting it at Preston Montford and offering bursaries.

The focus of the course is on soil mite and springtail collection, preservation and identification, with background sessions on the importance of soil mesofauna for soil structure and function. It has proved extremely popular and attracts a wide range of participants including agriculturists, PhD students, wildlife gardeners and pan-species listers. This course will be run again in spring 2016 and will provide valuable feedback on the trial of a new soil mite key being developed by Matthew and Felicity.

One of the things Tom.bio is exploring is the ongoing support of participants after they have attended formal training courses. All too often people attend courses, making new contacts and learning a huge amount in an intensive few days, but then leave at the end and never continue with their learning. We want to try to overcome the barriers preventing people from developing their identification skills. As a consequence we are trialling a 'peer support' system, whereby previous Soil Mesofauna course participants are invited back to Preston Montford for a weekend of informal identification. This won't be a 'training course' as such, but simply two days where we make the facilities and equipment at Preston Montford available and allow people to share tips and problems, and build on their existing skills in a supportive environment. Hopefully we'll have some experts on hand to answer questions too.

Soil Mesofauna has also provided a focus for the 'upskilling' of the Tom.bio team. We are deliberately setting time aside to practice springtail identification, with the hope of becoming proficient enough to offer long-term peer support to soil

mesofauna recorders in the future. It also helps us better understand what is needed in terms of resources, support and problem solving for soil mesofauna identification.

Another barrier to ongoing invertebrate identification in general is a lack of specialist equipment, especially the expensive compound microscopes needed for soil mesofauna ID. We're lucky in that, at Preston Montford, we have access to the room, microscopes and library which are, in part, a legacy of the hugely successful Invertebrate Challenge project outlined above, as well as equipment purchased for Tom.bio. Not everyone is in a position to access such equipment at home, so we are now making these project facilities available for use by anyone who wants to use them for biological identification.

The Earthworm Project

Working with enthusiastic partners and adding value to their work is a key part of Tom.bio's remit. Our Earthworm project showcases this approach. Like soil mesofauna, earthworms are massively under-recorded in the UK – a quick search of the NBN distribution maps for one of our commonest worms, *Lumbricus terrestris*, reveals fewer than a dozen records for this species in Wales and Scotland. They have immense economic value due to their role in breaking down vegetation and soil particles, aerating soil and allowing valuable nutrients to be released. It's not too overblown to say that our farming industry would be non-existent without the humble earthworm. Given this, it seems strange that they remain such an incredibly under-recorded group.

As well as the clear need for more data on their distribution, another great reason to focus on earthworms is their tractable identification – with only 27 UK species, determined using a handful of easily seen characteristics and a standard low power microscope, their identification is not as daunting as for many invertebrate groups.

Our main partner in this project is the Earthworm Society of Britain (ESB). This is a young and dynamic London-based group, who have done a huge amount of work over the past few years to increase participation in the Earthworm Recording Scheme. In

March 2015 Tom.bio helped to host an ESB Field Meeting – a two-day format that combined a day sampling in the field with a day of identification in the lab – at Preston Montford. This became the most successful ESB Field Meeting to date in terms of number of attendees and new records generated. Participants were mixed in both age and experience. Ecological professionals and MSc students mixed with those for whom invertebrate work is an interest outside of their academic or professional life. Several attendees, including the Tom.bio team, have gone on to become regular earthworm recorders as a result of this field meeting.

In August 2015 Tom.bio followed this up by organising an inaugural Shropshire Earthworm Blitz. We welcomed back previous ESB Field Meeting attendees, together with earthworm novices, and travelled round the county sampling a range of different habitats. We were supported by Keiron Brown of the ESB, who came along to offer his expertise and assistance. Over 17 earthworm species were recorded during this weekend, several of which are classed as 'rare' – although this is likely to be a function of under-recording. Several species were also found in the 'wrong' habitat, illustrating that existing field guides are based on what little knowledge was available at the time of their publication, and may not represent the full story! Every earthworm record therefore adds significantly to the current pool of knowledge for this group of invertebrates.

One of the trade-offs Tom.bio is exploring is that of cost vs perceived value of training. In an ideal world the cost of training should not be a barrier to participation, but in reality the cost of courses – especially long residential ones – may be a significant barrier for some people. Tom.bio is trialling three methods of subsidising courses: complete subsidy, whereby courses are free to attendees; semi-subsidy, where all places are partially subsidised resulting in a cheaper course for everyone; and full price courses with associated bursaries, where bursaries are available for students and other non-professional participants. We trialled the first of these models for the Earthworm Blitz, making it a free, but



Record turnout for the Earthworm Society of Britain's field meeting at Preston Montford in March 2015. This picture was taken at nearby Powis Castle where the National Trust kindly permitted us to sample.

bookable, event – unfortunately several people who had initially booked cancelled at short notice or simply failed to turn up. We learnt the lesson that a free course – and the effort and expense which go into its delivery – may not be valued very highly by potential participants. A small fee, even if just a nominal amount, is probably more likely to result in committed, keen participants.

Going forward, Tom.bio is supporting the delivery of two further

two-day ESB Field Meetings during 2016, held at FSC centres in Devon (Slapton Ley) and Snowdonia (Rhyd-y-creuau). We will continue to support the growing network of earthworm recorders in the Shropshire area, and look forward to developing our partnership with the ESB.

Concluding remarks

Hosting externally-funded projects in the third sector requires a combination of skills across many areas including bid

writing, marketing, administration and delivery. FSC is well-furnished with such skills and, during its short existence, the Biodiversity Team has developed a reputation for delivering high-quality projects that have satisfied funders and participants alike.

If our goal was simply to deliver a series of standalone projects, we might be tempted to rest on our laurels, but it is not. The real goal, and our great challenge, is to formulate and deliver projects which have a lasting impact on the way FSC goes about its core business, helping it to navigate this changing landscape of natural history education. Over more than 70 years FSC has shown itself to be nothing if not resourceful and adaptable and there is every reason to hope that it will still be delivering education in field ecology and natural history skills in another seventy years' time.



Attendees of the Earthworm Society of Britain's field meeting at Preston Montford in March 2015 carrying out soil pit samples for earthworms.



Earthworms collected during the Shropshire Earthworm Blitz.

Society News

Insect Festival 2015

Insect Festival Team 2015
Luke Tilley and Gordon Port

A conservative estimate of 1,700 people visited the fourth biennial Insect Festival at York on Sunday 5th July. This made 2015 was the most successful Insect Festival yet and the audience for this family event continues to grow. The day dawned sunny and warm in the York Museum Gardens and Hospitium and the weather was kind until a short but heavy rain shower temporarily interrupted the day's festivities towards the end of the event. However, spirits were not dampened and the majority

of the visitors outside took cover and perused the indoor exhibits instead.

This year there were more live exhibits and interactive activities than ever. There was a continuous stream of visiting children (and adults) between 10am and 4pm, all wishing to carefully handle invertebrates, build insect models and learn about insect conservation projects and research. Thirty-four exhibits were on offer in the historic Hospitium and outside in the marquees. We had many popular exhibitors from previous years

returning, such as the Yorkshire Naturalist's Union and the Yorkshire Wildlife Trust, with a good representation of research organisations, including Fera, Stockbridge Technology Centre and the Pirbright Institute.

As always, the minibeast hunts were hugely popular with younger visitors and their parents. Participants signed up in advance for an insect hunt around the York Museum Gardens under the experienced guidance of Dr Roger Key and Dr Rosie Key, assisted by several



Happy to be blue. The face painting tent in full swing.



Family enjoying their sweepnet; inset: What's in my sweepnet? Children on a minibeast hunt.

enthusiastic student helpers. The weather was kind to the budding entomologists until the final hunt of the day had to be cancelled due to rain. However, the minibeast hunters were not disappointed but treated to an interactive talk about the invertebrates that can be found in the Museum Gardens instead.

The NIW display of winning photographs from the 2014 competition had its own tent, allowing visitors to browse the stunning collection at a more leisurely pace. The winning drawings from the Insect Festival Art Competition for Schools were also on display (plus the folders of all the 850+ entries). There was a prize giving at 1pm for the winners to receive their insect themed prizes. The school of the overall winner also received £250.

ART COMPETITION PRIZE WINNERS

4-5 YEARS OLD

- 1st Mia Chan,
Birstwirth C of E Primary School
- 2nd Eden Siddle,
Headlands Primary School
- 3rd Benny McNeill,
St Martin's Ampleforth

6-7 YEARS OLD

- 1st Henry Johnson,
St George's RC Primary School
- 2nd Sibylla Burrows,
St Martin's Ampleforth
- 3rd Henry Sharp,
Roecliffe C of E Primary School

8-9 YEARS OLD

- 1st Jack Broad,
Burnt Yates Primary School
- 2nd Kiera Clements-Byrne,
St Martin's Ampleforth
- 3rd Raj Sharma,
Cookridge Primary School

10-11 YEARS OLD

- 1st Charlotte Owen,
St Martin's Ampleforth
- 2nd Isabel Moore,
Dobscroft Junior School
- 3rd Craig Njiri,
Three Lane Ends Academy

OVERALL WINNER

Florence Tidmarsh,
St Martin's Ampleforth

Antenna 2015: 39 (4)



All the organisations' logos from Insect Festival 2015.



LITTLE THINGS
THAT RUN THE WORLD



Volunteers ready for a busy day.

Insect Festival 2015

Art Competition: The Winners

INSECT FESTIVAL 2015

Age 4-5, First: Mia Chan



Age 4-5, Second: Eden Siddle



Age 4-5, Third:
Benny McNeill



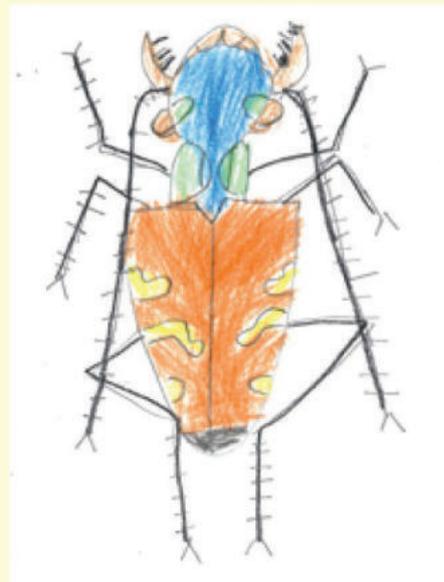
Age 6-7, First: Henry JF Johnson



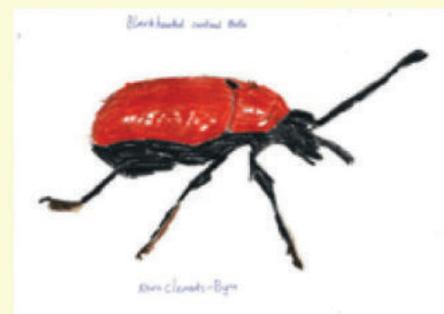
Age 6-7, Second: Sibylla Burrows



Age 6-7, Third: Henry Sharp



Age 8-9, Winner: Jack Broad



Age 8-9, Second: Keira Clements-Byrne



Age 8-9, Third: Raj Sharma



Age 10-11, Winner: Charlotte Owen



Age 10-11, Second: Isabel Moore



Age 10-11, Third: Craig Njiri



Overall Winner:
Florence Tidmarsh
Age 11 years

Where art meets entomology was explored further by two new exhibits by Alan Shaw (Itzbugginiz) displaying his extraordinary 3D S.E.M. images and Alberto Congosto-Nuñez (Insect Creator) displaying his fabulous insect facsimiles made from natural materials. Three children's authors participated in the day with Anneliese Emmans Dean, Mike Barfield and Sonia Copeland Bloom on-hand to sign copies of their books and talk to the children about their work and the insects they write about.

Overall, the day was a great success. The exhibits were diverse, interesting and interactive where possible, which attracted a wide range of people of all ages. We had a swarm of knowledgeable and enthusiastic volunteers, all in their eye-catching yellow t-shirts, taking turns at face painting, minibeast hunting, stewarding and model-making.

Support from the RES Officers Lin Field and Hugh Loxdale was much appreciated and their hands-on approach was certainly in the spirit of this activity-oriented event. As usual the RES HQ staff were outstanding, both in the preparation for the festival and in running things on the day. Special thanks must go to Kirsty Whiteford for all of her hard work.

Feedback on this year's event has been overwhelmingly positive. Insect Festival not only provides an accessible way for all ages to learn about insects and entomology but gives the exhibitors an opportunity to talk to each other and discover the public activities each organisation offers.

On behalf of the IF15 Team, we would like to thank all supporters, helpers, exhibitors and visitors in making this event the success it most definitely was. We hope the event continues to grow and offers even more opportunities to celebrate insects and their importance with the wider public.

If you would like to be involved in public events, including Insect Festival and National Insect Week, please contact Dr Luke Tilley (RES Director of Outreach & Development)



Author and poet Anneliese Emmans Dean talking about her work.



Family learning about ladybirds.



Insect Model making with the University of Plymouth.



Know your tree pests with OPAL Tree Survey.



A display from the entomology collections of the York Museums Trust.



Author Mike Barfield dressed for the occasion.



Author Sonia Copeland Bloom with staff from Stockbridge Technology Centre.



Learning to use a microscope at the Bumblebee Conservation Trust exhibit



3D S.E.M. images of insects by Alan Shaw.



Meet the cockroaches with Fera.



Learning about aquatic insects with the Riverfly Partnership.

Diary of the Acoustic Communication Course 2015

The Royal Entomological Society Report – Outreach Fund – August 7-20, 2015

Edith Julieta Sarmiento-Ponce

(js2139@cam.ac.uk)

PhD candidate in Insect Communication

Supervisor: Dr. Berthold Hedwig

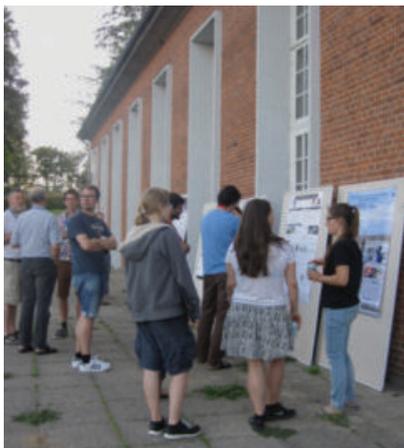
Reader in Neurobiology, Department of Zoology, University of Cambridge

The Acoustic Communication Course, a competitive entry course organized by the Sound, Communication and Behaviour Group, University of Southern Denmark, consisted of Technical lectures, MATLAB signal analysis exercises, Sound measuring practicals, and Bioacoustic lectures. I was fortunate enough to be able to attend this course with the help of an Outreach Fund from the RES, for which I'm extremely grateful. The course, outlined below, was an invaluable learning experience that will greatly assist me during my PhD and beyond.

Sound in air (1st part of the course)

Friday 7th August 2015 – Arrival into Søgaard Biological Station, Denmark, and registration to the course. Welcome and presentation of teachers and students.

Saturday 8th August 2015 – Jakob Christensen-Dalsgaard gave an Introduction to the sound field, followed by a Microphone essentials lecture by Lasse Jakobsen. MATLAB exercises working with dB were performed. After lunch, we attended two of the four basic practicals: 1. Microphone calibration, and



2. Recording sounds, followed by a data analysis exercise based on these labs. After dinner, we presented our projects in the first of two poster sessions.



Sunday 9th August 2015 – Coen Elemans talked about Recording equipment, followed by a MATLAB practical on how to measure signals and noise. After lunch, we attended two more of the four basic practicals: 3. Loudspeaker essentials and 4. Measuring vibrations, followed, as previously, by data analysis based on these labs. After dinner, we had two lectures: History of bioacoustics by Axel Michelsen, and Adventures in neuroethology by Peter Narins.



Monday 10th August 2015 – Coen Elemans discussed Acoustic analysis software options, followed by a MATLAB practical on filters and filtering. After lunch, we received feedback on the four basic practicals, and we had a lecture on Microphone array principles by Lasse Jakobsen. After dinner, Signe Brinklov delivered a lecture on Bat biology, and, appropriately, we then went on a Bat excursion.



Tuesday 11th August 2015 – Sue Anne Zollinger gave a lecture on Common parameters in papers and pitfalls. This was followed by a MATLAB practical on common parameters in bioacoustics. After lunch, we attended two of the four advanced practicals: 1. Playback calibrated signals, and 2. Sound degradation, followed by data analysis of these labs. After dinner, we had two lectures: Sound perception by Jakob Christensen-Dalsgaard, and Sound production by Coen Elemans.



Wednesday 12th August 2015 – Mark Johnson talked about Matched filters, followed by a MATLAB practical on isolate vocalizations from recordings. After lunch, we attended the remaining two of the four advanced practicals: 3. Enclosure acoustics, and 4. Unwanted reflections, followed by data analysis. After dinner, we had two lectures: Sound degradation by Ole Næsbye Larsen, and Communication distance prediction by Robert Dooling.



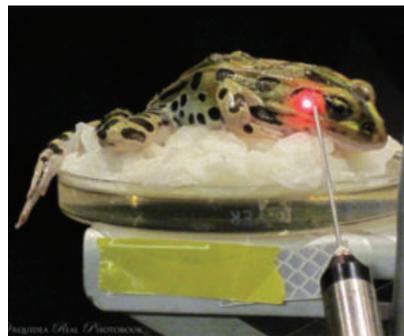
Thursday 13th August 2015 – We prepared a PowerPoint presentation explaining the advanced practical that was assigned to our team. After lunch, we did our group presentation. After dinner, we packed-up and travelled to the second venue for the course in Kerteminde Byferie.



**Underwater sound
(2nd part of the course)**

Friday 14th August 2015 – We travelled to the University of Southern Denmark, Odense, where we attended two of the four demonstrations in the morning: 1. Array-recordings of bats,

and 2. Laser Doppler vibrometry measurements. After lunch we attended two of the four demonstrations in the afternoon: 3. Auditory brainstem response measurements, and 4. Signal detection theory practical. Following this we undertook the first evaluation of the course. For dinner we had a BBQ, and then we returned to Kerteminde.



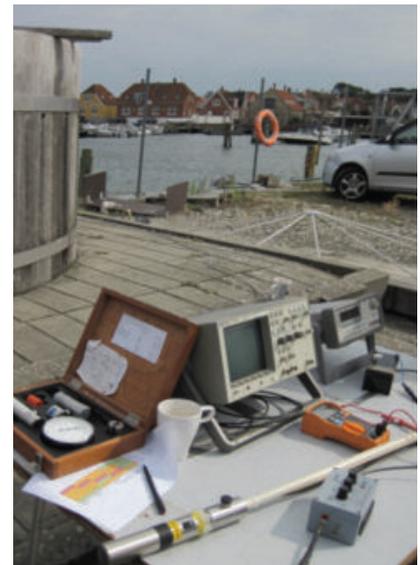
Saturday 15th August 2015 – Two students and I went to Odense on our day off. After dinner, there was the presentation of the new teachers and students, in addition to a lecture on the History of marine bioacoustics by Peter Tyack.

Sunday 16th August 2015 – Magnus Wahlberg gave a lecture on hydrodynamic sound. This was followed by a lecture on Hydrophone essentials by Peter Teglberg Madsen, and a MATLAB practical on clip levels and received level. After lunch, we attended two of the four underwater practicals: 1. Hydrophone calibration, and 2. Harbour porpoise prey capture, followed by a data analysis session. After dinner, we presented our projects in the second poster session.

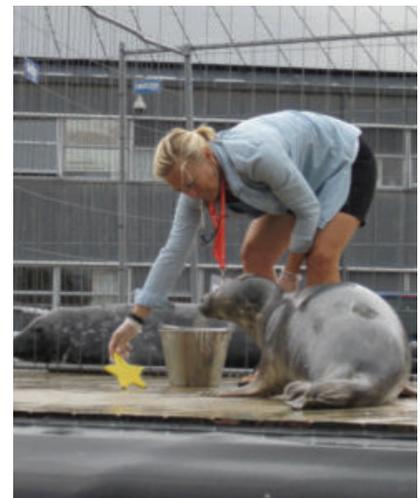


Monday 17th August 2015 – Mark Johnson talked about Tag methodology, with a talk on Passive Acoustic

Monitoring then delivered by Jakob Tougaard prior to a MATLAB practical on data analysis of acoustic signals. After lunch, we attended the remaining two of the four underwater practicals: 3. Target strength and scatter, and 4. Measuring underwater signals and noise, followed by data analysis based on these sessions. After dinner, Peter Teglberg Madsen gave a lecture on Whale echolocation.



Tuesday 18th August 2015 – Jakob Tougaard gave a lecture on Theoretical psychophysics. This was followed by a lecture on Practical psychophysics by Colleen Reichmuth, and a MATLAB practical on goldfish ABR demonstration by David Mann. We also observed a Psychophysics demonstration in a seal by Kirstin Hansen. After lunch, we participated a Psychophysics ROC exercise, followed by data analysis of this exercise. After dinner, Peter Tyack gave a lecture on Acoustic communication in whales.



Wednesday 19th August 2015 – We attended three lectures in the morning: 1. Sound communication in fish by David Mann, 2. Hearing in fish and marine invertebrates by David Mann, and 3. Hearing in marine mammals by Magnus Wahlberg. After lunch, we prepared our second presentation, from one of the underwater practicals, and presented to the group. For dinner we had a Swedish crayfish party!



Thursday 20th August 2015 – The second course evaluation was undertaken, certificates were presented and we had a farewell talk. We then returned home, full of new knowledge, inspirational ideas and newfound friends!



UNIVERSITY OF CAMBRIDGE

COMPARISON OF PHONOTACTIC BEHAVIOUR IN FOUR LINES OF CRICKETS (*Gryllus bimaculatus*)

Sarmiento-Ponce E.J.*, Nakamura ** T. Milo T.***, Noji S.** & Hedwig B.*

* Department of Zoology, University of Cambridge, Downing Street, Cambridge, CB2 3EJ, United Kingdom

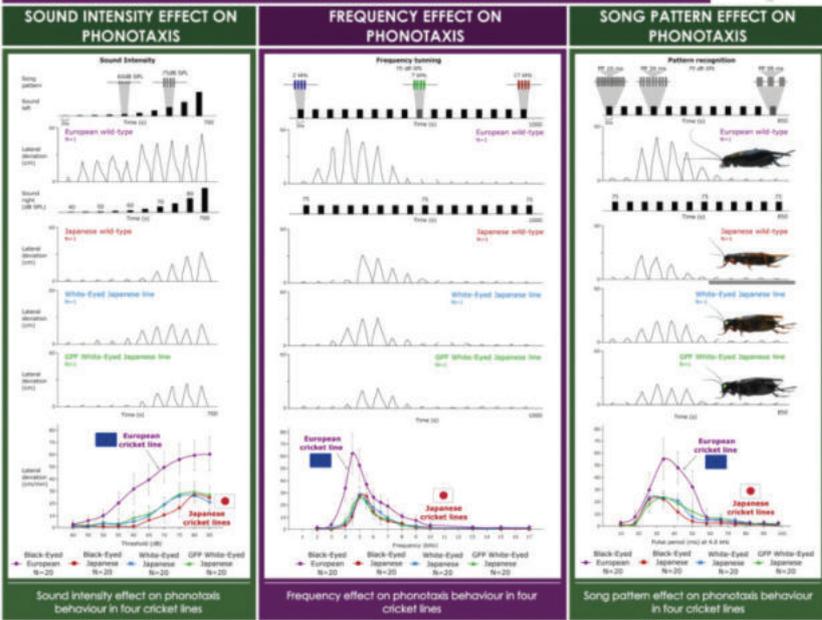
** University of Tokushima 2-24, Shinkuro-cho, Tokushima 770-8501, Japan, js2139@cam.ac.uk



UNIVERSITY OF SOUTHERN DENMARK

INTRODUCTION

- Acoustic communication in crickets drives mating behaviour. Phonotaxis is the behavioural process in which females are attracted to calling songs that males produce through rhythmic movements of their wings (Hedwig 2006).
- In this study, a comparison was performed between European wild-type, and three Japanese lines (wild-type, white-eyed type, and GFP white-eyed (Nakamura et al. 2010)). Three phonotaxis parameters were measured in females walking and steering on a trackball: Intensity response, Frequency tuning and Pattern recognition.



CONCLUSION

- The phonotaxis behaviour of the four cricket lines showed a similar trend for each parameter. However, the European wild-type responded significantly better in comparison to the three Japanese lines (black-eyed, GFP, and white-eyed), which all demonstrated a similar lower performance. The similarity in the performance of the three Japanese lines (black-eyed, white-eyed, and GFP white-eyed) demonstrates that neither the white-eyed mutation nor the genetic GFP insertion are affecting phonotactic behaviour in these lines, from our results the difference depends on the geographic origin of the crickets.

REFERENCES

Hedwig B (2006) Pulse pattern and acoustic communication in crickets. *J Comp Physiol A Neuroethol Sensory Behav Physiol* 192:77-98.
Nakamura T, Takahashi M, Ogihara T, Shimizu M, Nakamura T, Noji S, Milo T, Noji S, Milo T (2010) Imaging of transgenic cricket embryos reveals cell rearrangements created with a smooth partitioning mechanism. *Current Biology* 20(16): 1447-1457

SPONSORS



ACKNOWLEDGEMENTS

We sincerely thank Miss Louise Barrett for the cricket pictures. Our deepest appreciation to my sponsors: Graduate School (SNU), University of Southern Denmark, Odense, Royal Entomological Society, Newnham College. A special acknowledgement to CONACIT and Cambridge trust for funding my PhD course.

Ed Jarzembowski 2015 Jiangsu Friendship Award



Congratulations to Ed Jarzembowski, who has received a Friendship Award from the Jiangsu Province of China (which has a larger population than the whole of the UK). The “Jiangsu Friendship Award” is the highest award of Jiangsu Provincial People’s Government for foreign experts, and is given in recognition of outstanding contributions to Jiangsu Province with regard to economic progress and social development. The award was presented to Ed by the Provincial People’s Government at a ceremony in September. Ed has been Visiting Professor at the Nanjing Institute of Geology and Palaeontology, Chinese Academy of Sciences, Jiangsu, since 2012, where his research into fossil insects has led to the publication of many papers with colleagues at the Institute. He has studied and undertaken fieldwork on mainly British fossil insects since the 1970s, and his work at Nanjing has allowed him to explore the links between the English Wealden and exceptionally preserved Lower Cretaceous Chinese fossil insect faunas. The provincial government in Liaoning has recently helped found a new palaeontological museum there, and a new amber inclusions museum is anticipated along the Yangtze.

Peter Austen, *Wealden News*

Cuticle materials and chemistry: towards a car that moults

Bernard Moussian

On September 8th and 9th the Arthropod Cuticle Special Interest Group (SIG) of the Royal Entomological Society brought together 27 scientists working on multifarious aspects of the cuticle at Dresden in Saxony. As far as we know, this was the first SIG meeting to take place outside the UK. Many of those attending were German, but scientists from six nations were present. To attract bio-materialists, zoologists, physiologists and molecular biologists, and thus ferment a fertile interdisciplinary atmosphere, the meeting's themes were "Cuticle Material Properties" and "Cuticle Chemistry". The idea that insect cuticle can provide a model for technological innovation was also a sub-theme.

The meeting began with a tour of the Max-Bergmann Center of Biomaterials (a joint initiative of the Technical University (TU) of Dresden and the Leibniz Institute for Polymer Research) where the director of the "Biomaterials" department, Hans-Peter Wiesmann, reported on the exciting and astonishing activities of his research group, which is part of one of the most important centres of German biomaterials research.

The meeting continued under the aegis of the hosts Stuart Reynolds (University of Bath), Klaus Reinhardt and Bernard Moussian (Applied Zoology, TU Dresden) in the Biology department building; a wonderful architectural masterpiece, by the way.

A central issue of several presentations was the cuticle surface, where contact with the environment is made with distinct structures and specific chemistry, both required for the insect to occupy its ecological niche. In his keynote presentation, Thomas Schmitt from Würzburg University addressed the role of surface hydrocarbons (HC) in interactions between hymenopteran species competing for the same resources. The cuckoo wasp female, for instance, sports a cocktail of HCs also found at

the surface of the digger wasp. With this cocktail the cuckoo wasp is able to enter incognito the digger wasp's brood cells and there deposit its eggs on the paralysed honeybee that was intended to serve as a food source for the larvae of the latter. Thomas also reported on a new substance class, Crematoenones, identified at the cuticle surface of the ant *Crematogaster modiglianii*. Crematoenones potentially appease *Camponotus rufifemur* ants that host *Crematogaster modiglianii* in their nest. In the next talk, Tobias Otte (Free University Berlin) demonstrated that HC production depends on the food source. Moreover, males of the leaf beetle *Phaedon cochleariae* recognized females that had fed on the same plant species and preferred to mate with them. Subsequently, Julia Nickerl (IPF, Dresden) and Jonas Wolff (University of Kiel) focused on cuticular surface structures in Collembola (regular comb-like patterns, figure 1) and arachnids (hairs with viscoelastic droplets), respectively, that have quite

opposite effects: repulsion of liquids and dirt and high adhesion.

After an evening's sampling of local (beer) flavour, the next day started with the second central theme of this meeting - cuticle stability. Applying high-end technology at the Max-Planck Institute of Colloids and Interfaces in Potsdam, Yael Politi showed in her keynote presentation how chitin orientation in the cuticle of the spider *Cupiennius salei* defines the physical properties of specialized cuticular organs such as fangs. Sebastian Kruppert (University of Bochum) shared his data on the ultrastructure of pillars that connect the upper and lower parts of the carapace of *Daphnia*. He speculated that the pillars withstand tensile rather than compressive forces. Among others (e.g. surface bacteria, figure 2), Jasna Strus (University of Ljubljana) detailed her studies on possible habitat-borne differences in cuticle thickness and colour in isopods. Stuart Reynolds spoke about the distribution of zinc, its

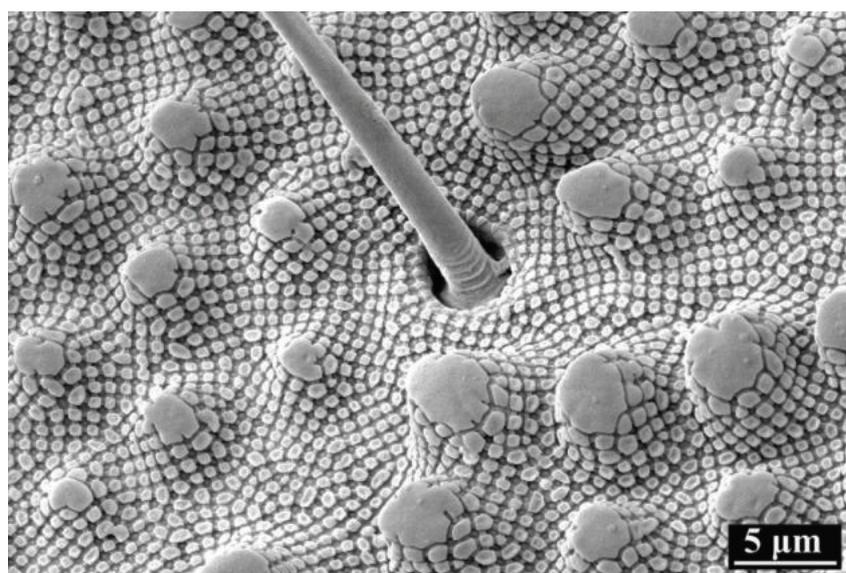


Figure 1. SEM image of the cuticular morphology of *Tetrodontophora bielanensis* (Collembola). The hierarchically structured cuticle is characterized by a tertiary structure in form of thin bristles, a secondary structure built by papillose microstructures (secondary granules) covered by the primary structure, a rhombic comb-like mesh exhibiting nanoscopic tubercles (primary granules) which are connected by ridges. Image provided by Julia Nickerl (IPF Dresden / Max Bergmann Center of Biomaterials).

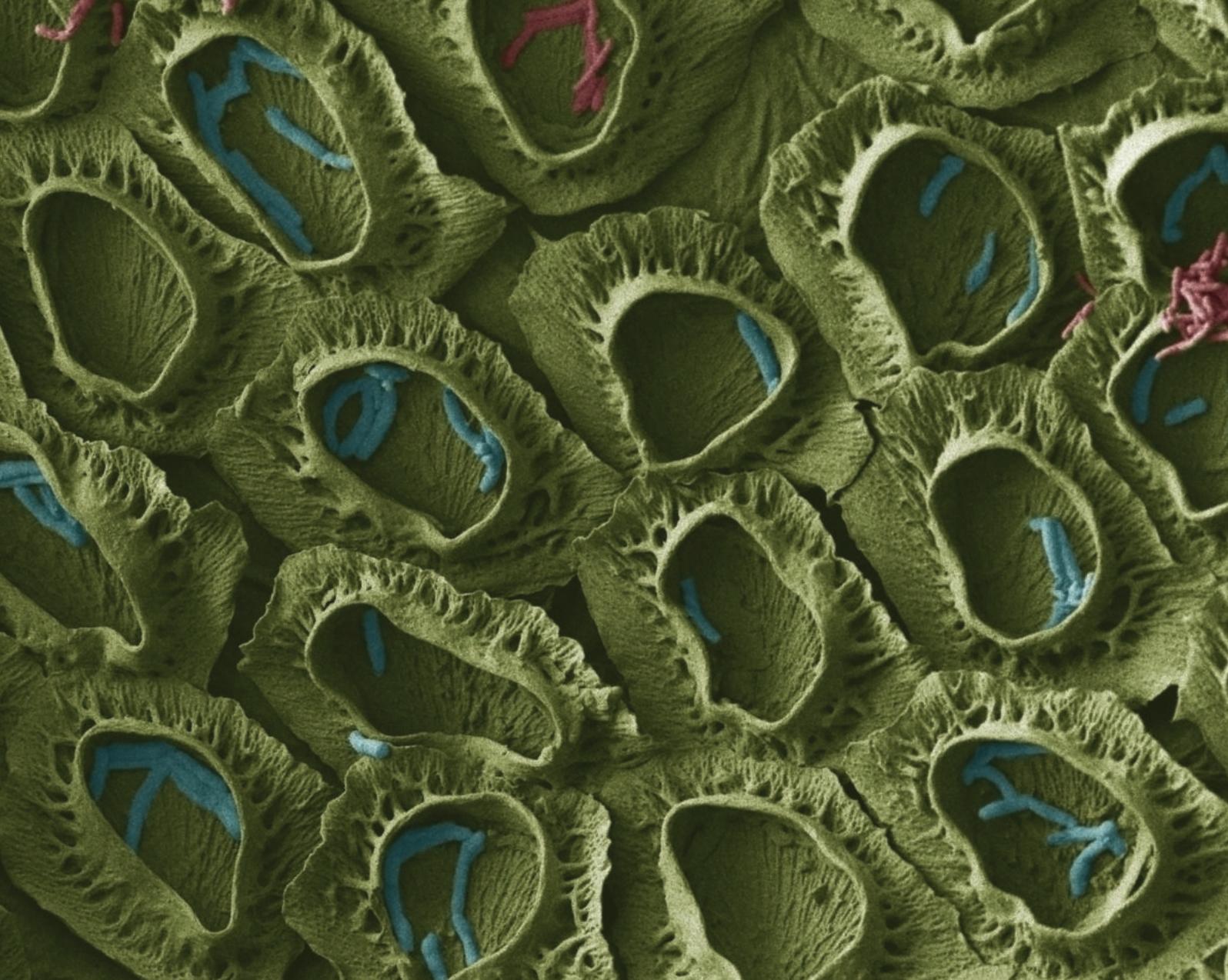


Figure 2. Scanning electron micrograph of the cuticular surface in the terrestrial isopod crustacean *Platyarthrus hoffmannseggii* with epibiotic bacteria (magnification 2700x). Image provided by Jasna Strus and Milos Vittori (Department of Biology, University of Ljubljana).

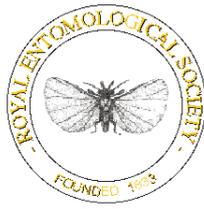
dependence on pH value and its association with histidine-residues in cuticle proteins in the mandibles of the lepidopteran *Manduca sexta*. Based on his comparative data on cuticle sclerotisation, Tsunaki Asano (Tokyo Metropolitan University) speculated boldly that the use of organic cross-linkers of cuticle components is an evolutionary answer to calcium shortage after the colonisation of land by insects. Three additional contributors variegated the meeting with other approaches to cuticle. A remarkable issue was brought up by Stefan Fränzle (Technical University Dresden). He provided evidence that chitin can absorb metal ions in living insects and can therefore be used for bio-monitoring. Molecular mechanisms of cuticle formation were detailed by Matthias Behr (University of Leipzig). He summarised his work on the factors

functioning in the assembly zone of the *Drosophila* cuticle in order to organise the nanofibrillar architecture of chitin in the cuticle. A particular topic concerned infrared (IR) receptors in beetles (e.g. ash beetle) that are adapted to burning environments, as described by Helmut Schmitz (University of Bonn). In these insects, specialised regions of the cuticle in the thorax absorb radiant heat remotely monitoring the temperature of objects in the environment, allowing appropriate responses to be elicited.

Overall, the plan of the hosts to promote interdisciplinary exchange was successful. While the proceedings of the meeting were entirely in English, the zoo of participants nevertheless spoke a variety of different scientific languages, from chemistry and molecular biology to behaviour. As a result, intellectually fertile debates

erupted after virtually each presentation. One of these verbal sparring matches led to the biomimetic vision of a moulting car, let's say in the shape of a beetle. An amusing but also stimulating idea! At the same time, technical and methodological issues were deeply discussed. The meeting was also satisfyingly inclusive; all poster presenters were able to talk briefly to the entire group about their work.

At the end of the meeting, many participants embarked on a short suburban train journey along the banks of the Elbe to the nearby fabulous forests of Saxon Switzerland, where a short walk and spectacular climb to a hilltop tavern served to refresh the troop of cuticle scientists after the friendly skirmishes of the scientific sessions. This was an intense and successful get-together, which will hopefully resume in Bath next year.



The Royal Entomological Society MSc Scholars 2015

Simon Leather

Professor of Entomology, Harper Adams University

This year the Royal Entomological Society generously increased the number of scholarships to aid aspiring entomologists wishing to study the MSc in Entomology at Harper Adams University from three to five. We are incredibly grateful to them and it is an indisputable fact that the availability of these scholarships has helped swell the numbers of entomologists graduating in the UK. We had an incredibly tough time deciding who to award the scholarships to, and after much soul-searching picked the following from a very competitive field.

Harry Simpson



Since completing an undergraduate degree in International Wildlife Biology, I have been working hard to support myself whilst also acting as a volunteer for many organisations. These volunteer placements have expanded my skill set greatly and fuelled my enthusiasm for a deeper understanding of invertebrates. It also made me more determined than ever to succeed in the pursuit of becoming an entomologist and thus I applied to study MSc Entomology at Harper Adams University. However, the voluntary placements I undertook were by their

nature unpaid and whilst I have been combining my voluntary work with part-time paid work in order to fund my studies, it has proven very difficult. I realised that I would struggle to pay my tuition fees and accommodation without financial support. I applied for a Royal Entomological Society Bursary, which I was kindly awarded. I am very grateful for this award as it will give me the opportunity to focus my time upon my studies.

I made the decision to study entomology whilst participating in a six month Internship with the Earthwatch Institute. During my time with Earthwatch, I aided Dr. Alan Jones with his research into carbon dynamics monitoring and led volunteer-based research trips into Wytham Woods, Oxford. During these excursions we undertook many tasks, such as conducting tree measurements, lepidopteran surveys, pit fall trapping, mammal tracking and leaf litter surveys, all of which helped me to gain experience of forestry research techniques, data collection and data manipulation. I was also fortunate to be invited to attend several lectures conducted by Dr. George McGavin on the subject of entomology, which was particularly inspiring.

I have always been interested in entomology. However, it was after the above experiences with Earthwatch

that I realised how much I wanted to pursue it as my career. The lectures I attended further cemented the importance of insects, especially in agriculture and food security, waste management, biodiversity and numerous other vital services taken for granted yet provided for free, by insects. I was subsequently inspired to apply to Harper Adams University.

My experiences at Earthwatch also led me to develop a keen interest in the impacts associated with habitat fragmentation and edge effects in British woodlands. It is for this reason that I am keen to learn more about 'The Biology and Taxonomy of Insects' and 'Advanced Research Methods', two modules I will be studying at the university. I hope to use these topics as a foundation for conducting a research project to investigate the relationship between edge effects in British woodland and insect biology and diversity. I believe that the use of invertebrates as an indicator of edge effects would be of great importance in future forest management and sustainability.

I am eternally grateful to the Royal Entomological Society for their support, as with this bursary I am able to attend Harper Adams University and can now pursue my ambition of becoming an applied entomologist.

Thank you.

Liam Crowley



Electing to study entomology was an inevitable choice for me. I was fortunate enough to discover the subject in earnest whilst completing my undergraduate degree and subsequently realised that I had found my vocation. Whilst I still possess an intense interest in wider ecology and natural history, it is the study of entomology that really inspires me most. I have come to realise how integral insects are in the functioning of terrestrial ecosystems and their role in wider conservation. Time and again I find myself astounded at the sheer diversity of the group, not only in terms of different taxa but also the range of ecologies and life histories included within it.

I fully intend to pursue a career in entomological research. In particular I am interested in how insects interact with the wider ecosystem and their role in the provision of ecosystem services. I was able to explore and develop this interest whilst completing a student placement with the Farmland Ecology department of the Game and Wildlife Conservation Trust. This involved 12 months of ecological research, with a focus on entomology, where my understanding of the intricate and vital relationship between insects and food production was reinforced. In addition to this I have also had the opportunity to gain international entomological experience in Canada (studying mountain pine beetle), India (pollination by bees) and in Trinidad (social evolution in wasps). Furthermore, being a member of a number of entomological organisations such as the RES has allowed me to immerse myself into the entomological community and I have greatly enjoyed the opportunity to converse with like-

minded people. These experiences have provided me an insight into how entomological research is conducted and reaffirmed my desire for a career in this area.

The Entomology MSc was therefore the logical next step and I will greatly enjoy my time studying it. For someone as interested in entomology as myself, it is difficult to pick out particular modules that I believe I will find most interesting as I am certain I will relish all aspects of the course. However, due to my aforementioned interest in the role of insects in ecosystems, the 'Ecological Entomology' and 'Biodiversity and Ecosystem Services' modules certainly stand out as ones which I will definitely enjoy.

Receiving this bursary should prove to be an invaluable asset in the pursuit of my career in entomological research. Not only is it beneficial in terms of the financial support but also with the associated recognition of having been awarded the honour. This should undoubtedly aid in securing a high quality PhD studentship which I feel is my next step after completing my Masters.



Jenna-Violet Shaw

I am so excited to have received this scholarship from the Royal Entomological Society! Many years have been spent working hard to reach this point and gaining this bursary is one of the key reasons I was finally able to get here! I am thrilled to have been given funding and a place on the Entomology Postgraduate course at Harper Adams and I am particularly excited to study the 'Biology & Taxonomy' and the 'Diversity & Evolution of Insects' modules, as these subjects have fascinated me ever since I can remember. To gain the depth of

knowledge provided by this course will be outstanding and will open up a wonderful range of career opportunities that I will not hesitate to grab. Of course, the research project that I shall carry out during this degree is something I am very much looking forward to, as research projects have always been my strength throughout academia, perhaps mainly due to my enthusiasm.

Insects are the magnificent backbone to biodiversity and environmental health and I aspire to dedicate my career and life to the understanding and conservation of insects. To be able to embark on this wonderful journey and career with a Master's degree in Entomology is phenomenal.

This scholarship will greatly aid in both research and living costs, thus allowing me to undertake this course. I feel truly honoured to be given this opportunity. I will not waste a single penny of it and will dedicate my future career to the preservation of the natural environment and insects (and I look forward to it!).



Ruth Carter

I am honoured to be a recipient of the Royal Entomological Society scholarship to study MSc Entomology at Harper Adams. From how entomologists give ants contact lenses, to reading an aphid's senses/brain by electrophysiology or listening to stag beetle larvae, entomology is a thoroughly interesting field which I wanted to be a part of since the age of

Why I have selected to study my chosen course.

Since the age of 13 I have been self-financing every summer holiday of work experience. I have just returned from a 12 week internship at the Austrian Institute of Science and Technology. At the end of each summer it has always been rather disappointing to go back to school/university knowing that I still had years left before I could start a Masters in Entomology. My final step on the way to becoming a Research Entomologist will be a PhD. The design and analysis module is therefore of key interest to me.

Other modules in my chosen programme that are of particular interest to me

I am fascinated by insects and their complex lives and the potential to use insects to solve some of the world's problems; from using witch weed as a trap crop in African agriculture to eradicating Dengue fever. It amazes me that insects have been around longer than us, have a far greater population, and influence our lives so greatly, yet we still know so little about their lives. I hope to unlock some more of the insects' secrets.

I will use the Biology and Taxonomy module to help improve my collection skills, ones that will be essential for organising the next Young Entomologist dinner in East Keswick. I also love the Diversity and Evolution of Insects module, as the breadth among insects fascinates me.

Previous academic qualifications in this area of study

With regards to my undergraduate degree, my favourite part was writing the dissertation and carrying out a research project. Although I love the whole of entomology I am particularly fascinated by the connections between different insect species and the links between insects, fungi and bacteria. These were the areas touched on during my research project, IST internship and dissertation, and I would love to explore these areas further.

Difference the receipt of the scholarship would make in the pursuit of my goals

The scholarship has allowed me to invest the time I would spend doing a part time job into time at the Entohub

and Ento'16. I will even be able to write a paper so I can give a talk at the 2016 International Congress of Entomology. I feel that the less time I spend raising money to finance my work, the more I will be able to achieve in the academic sphere. Additionally, by keeping future loan repayments at a manageable level, a scholarship will make it possible for me to continue studying for a PhD in entomology.

Scott Dwyer



I am one of the current RES Bursary recipients of £4,000 towards the study of the MSc Entomology course at Harper Adams University in the academic year 2015-16. I have selected to study entomology due to my fascination and interest in the subject, as well as the importance of understanding insects in the world we live in today. The fact that they dominate in number and volume and are hugely diverse in the niches they have and the roles they play, e.g. pollination, nutrient cycling and seed dispersal, make the group hugely interesting to me.

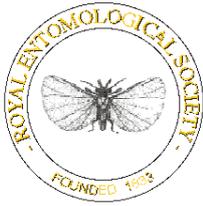
The intensification of agriculture and changing rural landscape due to human modification will undoubtedly affect some species. Further understanding of pest species and how they arise will become increasingly important as we aim to become more sustainable. The short life span, high fecundity and ease of laboratory culturing of many insects have also proven invaluable for the study of evolutionary mechanisms. I feel there is an importance for me to study entomology not only due to my specific interest and passion to do

research, but also to educate others in my future career through outreach and public engagement.

I am looking forward to a variety of modules on the course. Modules of particular interest include the Biology and Taxonomy of Insects, which will allow me to broaden my horizons across insect orders. I also enjoy learning about morphological features of the different orders and their taxonomy. The Diversity and Evolution of Insects module also looks extremely fascinating, having studied insect diversity and insect-plant interactions at undergraduate level. I find insect behaviour particularly interesting, such as courtship and mating strategies, as well as the evolution of eusociality. The advanced research methods module also appeals to me as I love statistics and look forward to having more experience with the program R, as well as recapping over experimental design and statistical models. Insect Physiology is also appealing due to my current understanding of honeybee anatomy and physiology, and building upon this will be exciting. I look forward to the Ecological Entomology module, particularly content on the effects of climate change upon insects, though also on the role of insects within ecosystems and methods for their conservation.

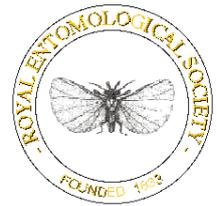
Receiving the scholarship has already made a significant difference to my time at Harper Adams by reducing the financial burden of the course. The extra funding has allowed for a greater investment in course materials such as books, trips and equipment – which will greatly improve my ability to learn and further myself on the course. After the MSc course I am determined to pursue further research within the realms of entomology. I would like to engage in research in topics relating to social insects and/or parasitoids. By receiving the scholarship I feel extremely lucky. After graduation ideally I would like to pursue a PhD, or other job opportunities, immediately without having to delay my career progression in order to pay back debt; thus the bursary has proven invaluable in the pursuit of my future goals.

For this opportunity and support from the Royal Entomological Society I am extremely grateful. I will endeavour to succeed.



SCHEDULE OF NEW FELLOWS AND MEMBERS

as at 2nd September 2015



New Honorary Fellows

Dr G McGavin
Professor W S Leal
Professor Z R Khan
Dr A D Watt
Professor S R Leather
Professor P Eggleston

New Fellows (1st Announcement)

Dr Roy Arthur Sanderson
Dr Anil Kumar Dubey

Upgrade to Fellowship (1st Announcement)

None

New Fellows (2nd Announcement and Election)

Dr Dana L Vanlandingham

Upgrade to Fellowship (2nd Announcement and Election)

Dr Gudbjorg Inga Aradottir

New Members Admitted

Dr Katherine Sinka
Mr Felix Stumpe
Miss Olga Maria Retka
Dr Rosalind Shaw
Professor Stephen James Coulson
Mr Wesley Paul
Mr Keith Waterhouse

New Student Members Admitted

None

Re-Instatements to Fellowship

None

Re-Instatements to Membership

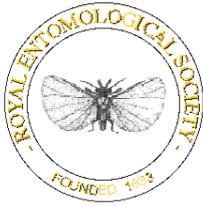
None

Re-Instatements to Student Membership

Ms Georgianne Jessica Kelley Griffiths

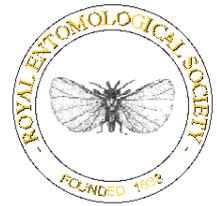
Deaths

Professor R M Elliott, 2013, Glasgow



SCHEDULE OF NEW FELLOWS AND MEMBERS

as at 7th October 2015



New Honorary Fellows

None

New Fellows (1st Announcement)

Dr Margaret C Hardy
Dr Vasuki Belavadi

Upgrade to Fellowship (1st Announcement)

None

New Fellows (2nd Announcement and Election)

None

Upgrade to Fellowship (2nd Announcement and Election)

None

New Members Admitted

Mr Jeroen Van Steenis
Dr Georgina Palmer

New Student Members Admitted

Mr Callum James Macgregor

Re-Instatements to Fellowship

None

Re-Instatements to Membership

None

Re-Instatements to Student Membership

None

Deaths

None

Book Reviews

British Moths A photographic guide to the moths of Britain and Ireland Second Edition

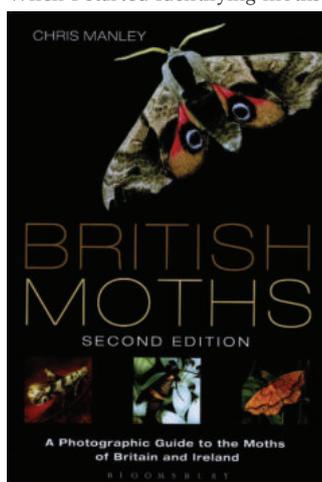
Chris Manley

£40.00

Bloomsbury Natural History 2015

ISBN: 978 14729-0770-7

When I started identifying moths in the mid-1970s there were few identification guides available. Mine were the two editions of South's *Moths of the British Isles* and a copy of Beirne's *Pyralid and Plume moths*, which I had on permanent loan from our local library, though by looking at the date stamps no one else had ever taken it out! It was a struggle and looking back at the books now I can see why. These days of course, the situation is different. We have an excellent selection of guides, websites and online help to which this book is an excellent addition.



After the success of the first edition the author has enlarged and refined the work, particularly in the inclusion of many more micro moths; 871 macro and 1,276 micro moths are now included. The illustrated index to moth families is followed by short sections on how to find and identify moths. The author is an accomplished insect photographer and gives sound advice on how to capture the best images of these beautiful insects. About 60 other photographers have also contributed to the book. In the past some photographic insect guides have suffered from the variable quality of images available. This is not the situation here. The plates include many superb images, particularly of the micro moths. They have been carefully selected and show the moths in the same orientation to allow direct comparison between species. It is good to see that multiple images are given for variable species. Selection of high quality images showing key field identification features results in an easy to use and pleasing design. A scale bar showing forewing length is given below each image. Where appropriate, images of leaf mines or larval cases are shown where identification is easier at this stage (e.g. the Coleophoridae). The text is shown on the opposite page and gives concise information on flight times and food plants, accompanied by a distribution map. The layout is based on the latest 2013 *Checklist of the Lepidoptera of the British Isles* by

D.J.L Agassiz, S.D. Beavan and R.J. Heckford, with log numbers identifying the plates which are cross-referenced to the text.

This is very much a field guide, and of course not all moths can be identified from live specimens. The text highlights this but does not give further information on diagnostic features (e.g. genitalia diagrams), but instead refers readers to other guides in the Bibliography.

I highly recommend this book to beginners and experts alike, and it is already a well-used addition to my library.

John Walters

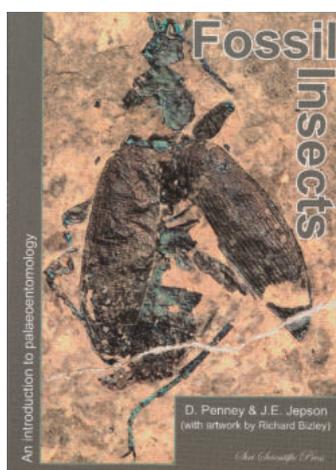
Fossil Insects

D. Penney & J.E. Jepson (artwork by R. Bizley)

£24.99

Siri Scientific Press

ISBN: 9780957453067



The insects are integral members of most terrestrial ecosystems, and have been for at least the last 300 million years. This deep evolutionary history is represented by a sometimes maligned, often underappreciated, but in reality very rich fossil record. *Fossil insects*, published by Siri Scientific Press, and written by David Penney and James Jepson, serves as an accessible introduction to the field of palaeoentomology. It begins with an overview of the history of the insects, in the form of summaries of the geology and insect life of periods since the Devonian. Following this are two more sections that help set the scene for the remainder of the book - an introduction to insects and their fossilisation, and an overview of techniques for studying insects. With these covered, the book delves deeper into the world of palaeoentomology, with an overview of significant fossil localities. These are organised geographically, and for each the authors provide a few sentences of overview, with details such as the deposits' lithology, age, and fossils that have been discovered there. The aforementioned introductory material and site list comprise the first half of the book. The second half has a large section titled "Diversity of Fossil Insects". This provides an ordinal-level overview of the insect fossil record; each order has a geological range, guide to identification of members of the group, extant biodiversity and then a paragraph on the palaeontology of the group. Considering the breadth of the literature, this is quite an undertaking, which is made significantly more complex by something of a divide in taxonomy between communities associated with Russian palaeoentomology, and the rest of the world. The book concludes with introductions to insect behaviour and ecology in the fossil record, sub fossil insects, and insect trace fossils.

All of this makes for a valuable overview to the palaeontology of the insects. It is pitched at the interested general reader, but covers enough ground that it is worth having as a reference book for those who are more conversant with the world of entomology or palaeoentomology. The book is lavishly illustrated, with 240 figures, several of which are painted palaeohabitat reconstructions by Richard Bizley - making it a

colourful as well an interesting read. There are relatively few books that fulfill a similar role to *Fossil Insects*. The closest is probably the very well-respected *Evolution of the Insects* by David Grimaldi and Michael S. Engel. These two books are complementary - the brevity of *Fossil Insects* makes it a lighter introduction than the latter (and the price tag is considerably lower than the now out-of-print *Evolution of the Insects*), whilst for further details and in depth introductions, Grimaldi and Engel is an excellent next step. I have few criticisms of Penney and Jepson's work - whilst reading I noticed occasional factual errors, but these are bound to slip into a work which covers so much literature. Overall I find *Fossil Insects* to be a much needed addition to the literature on fossil insects, with a price tag and length that makes it accessible - and of utility - to a wide range of readers. I believe that fossil insects could be incredibly valuable for answering myriad questions in evolution, terrestrialisation, palaeoecology and many other fields besides. With works like this, I am hopeful that more people will start to study them.

Russell Garwood - russell.garwood@manchester.ac.uk

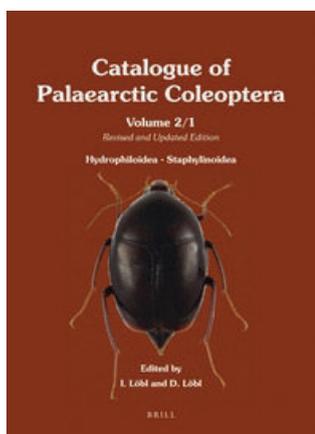
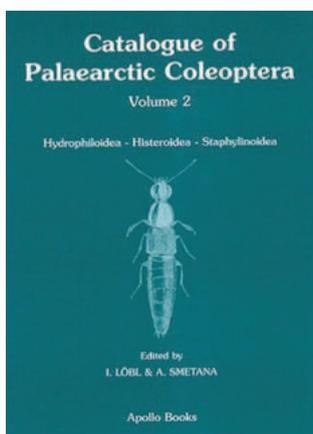
Catalogue of Palaearctic Coleoptera, Volume 2 Hydrophiloidea – Staphyloidea Revised and Updated Edition (2 vols)

I. Löbl & D. Löbl (eds.)

EUR: 189 /US\$: 245

Brill Publishing

ISBN: 978-90-04-28992-5



The volumes of the *Catalogue of Palaearctic Coleoptera* combine to form a work of outstanding scholarship and value, as well as occupying a considerable amount of bookshelf space. The original eight books which form the *Catalogue* appeared between 2003 and 2013, being published first by Apollo Books, and fortunately taken on subsequently by Brill. These eight volumes (or at least those relevant to the taxa in which one is particularly interested) are an essential resource for any serious study of the Palaearctic beetle fauna. In addition, the distributional data contained within such catalogues can form the starting point for biogeographical studies which attempt to understand the patterns one sees in the spatial distribution of biodiversity across the region. Personally, skimming through them has brought it home to me how diverse parts of the eastern Palaearctic are compared to the often impoverished west, a pattern whose scale I hadn't previously appreciated. Perhaps because taxonomy is accustomed to frequent reliance on historical works and older catalogues, I had assumed that these volumes

would not be updated anytime soon, and was initially surprised to hear that an update to Volume 2 was out. Spanning two volumes and over 1,700 pages, this revised and updated edition now lists 41,800 names in the Hydrophiloidea (used in the widest sense here, to include 'histeroid' families) and Staphyloidea, with 6,500 that were not listed in the first edition of 2004. It is also available as both a print and e-book for the first time. The editors and contributing authors are to be commended most highly for their commitment to the project, at a time when taxonomy is both sorely needed and underfunded. Indeed, the introduction to this edition contains one of the best and most accurate analyses of the current state of taxonomy which I have read. As the editors state: "*The on-going world-wide destruction of habitats resulting in a major biodiversity crisis demands an urgent assessment of what life is still left. Common sense suggests giving priority to taxonomy while it is still possible, rather than concentrating on other biological studies, such as evolutionary history, that can be conducted as well, if not better, in the future.*" A pity that common sense doesn't often prevail. They go on to quite rightly note that whilst there have been many conventions and initiatives devoted to 'biodiversity' in recent decades, this activity has rarely translated to concrete action in terms of support for the taxonomic bedrock itself. It is telling that of the new taxa included for the first time in this volume, about 80% were described by individuals lacking financial support. An additional factor responsible for the decline of taxonomy, in many countries at least, is the continued neoliberalisation of universities and research institutes, and the associated culture of metrics (e.g. Burrows, 2012) such as journal impact factors, which discriminate against fields with relatively low numbers of practitioners. Indeed, as noted by Valdecasas *et al.* (2000), such indices form one of the real threats to the *study* of biodiversity, and of course the recruitment of the next generation of professional taxonomists.

References

- Burrows, R. (2012) Living with the h-index? Metric assemblages in the contemporary academy. *The Sociological Review*, 60, 355-372.
 Valdecasas A G, Castroviejo S and Marcus, L F (2000) Reliance on the citation index undermines the study of biodiversity. *Nature*, 403, 698.

Dr David T Bilton
 Associate Professor and Reader in Aquatic Biology
 School of Marine Science and Engineering,
 Plymouth University

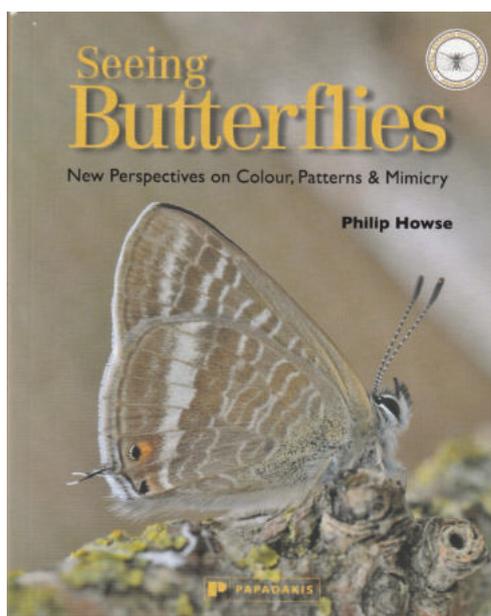
Seeing Butterflies *New Perspectives on Colour, Patterns and Mimicry*

Philip Howes

£16.99

Papadakis

ISBN: 9781906506469



'Seeing Butterflies' presents a fascinating new perspective in the way that visual predators perceive butterflies and moths. Philip Howes presents the reader with a series of intriguing ideas and offers a wide range of examples in support of them. We are all familiar with the concept that eyespots on Lepidoptera wings may deter visual predators, but Philip takes us on a journey that reveals a veritable menagerie hiding in their wing patterns. Snakes, mice and toxic caterpillars are just a small sample of this secret fauna that this book reveals.

The opening chapter discusses the nature of illusion with many examples from across the natural world and the arts. Chapter two examines the broad groups of strategies that Lepidoptera employ to deceive their predators and chapter three explores the way that Lepidoptera use colours in predator avoidance. The following chapters examine various groups of Lepidoptera exploring the range of defences exhibited by them.

The book is eloquently written and lavishly illustrated with a series of excellent photographs that illustrate and support the ideas advanced in the text. The text teems with quotes from biologists, artists and literature. My favourite was from J. D. Hooker who is quoted as saying "Above all remember that entomologists are a poor set, and it behoves you to remember this in dealing with them. It is their misfortune, not their fault, deal with them kindly".

Philip's ideas may be a little controversial and I am sure they will generate much discussion but I hope this book will stimulate new research in this field, which will answer some of the questions that he poses. "Seeing Butterflies" is thought provoking, entertaining and informative, and it has certainly altered the way that I now look at butterfly wings. It is a book which clearly demonstrates that Mr Hooker was misguided in his judgment of entomologists. 'Seeing Butterflies' is highly recommended to anyone who is curious about the natural world.

Peter Smithers

Diary

Details of the Meetings programme can be viewed on the Society website (www.royensoc.co.uk/meetings) and include a registration form, which usually must be completed in advance so that refreshments can be organised. Day meetings typically begin with registration and refreshments at 10 am for a 10.30 am start and finish by 5 pm. Every meeting can differ though, so please refer to the details below and also check the website, which is updated regularly.

Special Interest Group meetings occupy either a whole day or an afternoon (check www.royensoc.co.uk/meetings for details).

Offers to convene meetings on an entomological topic are very welcome and can be discussed with the Honorary Secretary.

If you are hosting a meeting or event of entomological interest and would like to advertise this to the RES membership please send details directly to antenna@royensoc.co.uk

MEETINGS OF THE ROYAL ENTOMOLOGICAL SOCIETY

2015

Dec 3 **Taxonomy SIG Meeting**
Venue: Natural History Museum Convenor: Andy Polaszek (a.polaszek@nhm.ac.uk)

2016

Feb **PG Forum**
11 – 12 **Venue: Harper Adams University, Shropshire**
Convenors: Claire Blowers (cblowers@harper-adams.ac.uk); Jordan Ryder (jryder@harper-adams.ac.uk)

Mar 2 **Verrall Lecture by Maxwell V. L. Barclay, Curator and Collection Manager, NHM**
"Collections – the Last Great Frontiers of Exploration"
Venue: TBC, London
Convenor: Dr Archie K. Murchie
The Verrall Association Meeting is in the Rembrandt Hotel, 11 Thurloe Place, a five minute walk from the Exhibition Road entrance to the Museum.

Mar 15 **Insect Endosymbiont Special Interest Group Meeting**
Venue: Oxford
Convenor: Ailsa McLean (ailsa.mclean@zoo.ox.ac.uk) Confirmed speaker: Prof Christoph Vorburger, EAWAG Switzerland

Apr 5 **2nd Annual Meeting of the Forest Insects Group**
Venue: Buglife – the Invertebrate Conservation Trust Peterborough
Convenor: Anne Oxbrough (Oxbrougha@edgehill.ac.uk)
Details to follow. For enquiries about submitting and abstract or discussion topic please contact the convenor.

Apr 11 **Entomophagy SIG**
Venue: Sutton Bonington, University of Nottingham
Convenor: Peter Smithers (psmithers@plymouth.ac.uk) For more information contact convenor.

Jun **National Insect Week**
20 – 26 **www.nationalinsectweek.co.uk**

Aug 29 **Aphidophaga 13 (13th International Symposium on the biology and ecology of natural enemies of aphids)**
– Sep 2 **Venue: Technical University of Munich, Germany**
Convenor: Professor Wolfgang Weisser
The 13th of a series of productive and friendly conferences founded in 1965 by Dr Ivo Hodek of the Czech Republic. Four days of plenary and offered papers are interrupted in the middle by an excursion which provides as great networking opportunity.
For further details, google "Aphidophaga 13" or contact h.f.vanemden@reading.ac.uk for an informal word.

Sep **Ento' 16 Annual Science Meeting**
6 – 8 **Venue: Harper Adams University College, Shropshire** Convenor: Prof. Simon Leather

Nov 2 **Climate Change SIG Meeting**
Venue: The Mansion House, Chiswell Green Lane, St Albans, Herts, AL2 3NS
Convenors: Keith Walters (keith.walters@imperial.ac.uk); Richard Harrington (richard.harrington@rothamsted.ac.uk)

Other Meetings

2016

Apr 26 **7th International Conference on Fossil Insects, Arthropods and Amber**
– May 1 **Venue: National Museum of Scotland, Edinburgh**
Convenor: Dr Andrew Ross
This is the main conference on the scientific study of non-marine fossil arthropods and amber. It is usually held every three years and this is the first time that it will be held in the UK. The conference will comprise of a Reception at the Royal Society of Edinburgh, three days of lectures at the National Museum of Scotland and two optional days of field-work to non-marine fossil arthropod sites. To be added to the mailing list and receive the 2nd Circular with instructions on how to register, please e-mail a.ross@nms.ac.uk

Sep **XXV International Congress of Entomology**
25 – 30 *"Entomology without Borders"*
Venue: Orange County Convention Centre, Orlando, Florida USA. For further details, please visit: <http://ice2016orlando.org/>

2018

Jul 2-6 **European Congress of Entomology**
Venue: Expo Convention Centre, Naples, Italy



author guidelines

We are always looking for new material for *Antenna* – please see below if you think you have anything for publication

AIMS AND SCOPE

As the Bulletin of the Royal Entomological Society (RES), *Antenna* publishes a broad range of articles of relevance to its readership. Articles submitted to *Antenna* may be of specific or general interest in any field related to entomology. Submissions are not limited to entomological research and may, for example, include work on the history of entomology, biographies of entomologists, reviews of entomological institutions/methodologies, and the relationship between entomology and other disciplines (e.g. art and/or design).

Antenna also publishes Letters to the Editor, Meeting Reports, Book Reviews, Society News, Obituaries and other items that may be of interest to its Readership (e.g. selected Press Releases). *Antenna* further includes details of upcoming entomological meetings in its Diary Section and features information and reports on RES activities including National Insect Week, Insect Festival and National, Regional and Special Interest Group meetings. Details of RES Awards and recipients are also covered, as is notification of new Members (MemRES), Fellows (FRES) and Honorary Fellows (HonFRES).

READERSHIP

Antenna is distributed quarterly to all Members and Fellows of the RES, as well as other independent subscribers.

INSTRUCTIONS FOR AUTHORS

Standard articles are normally 2,000-6,000 words in length, though shorter/longer submissions may be considered with prior approval from the Editorial Team. The length of other submitted copy (e.g. Letters to the Editor and meeting reports) may be shorter, but should not normally exceed 2,000 words. The use of full colour, high quality images is encouraged with all submissions. As a guide, 4-8 images (including figures) are typically included with a standard article. Image resolution should be at least 300 dpi. It is the responsibility of authors to ensure that any necessary image permissions are obtained.

Authors are not required to conform to any set style when submitting to *Antenna*. Our only requirement is that submissions are consistent within themselves in terms of format and style, including that used in any reference list.

PAGE CHARGES

There is no charge for publication in *Antenna*. All articles, including images, are published free-of-charge in full colour, with publication costs being met by the RES for the benefit of its membership.

REVIEW AND PUBLICATION PROCESS

All submissions are reviewed and, where necessary, edited 'in-house' by the *Antenna* Editorial Board, though specialist external review may be sought in some cases (e.g. for submissions that fall outside the Editorial Boards expertise). Receipt of submissions will be provided by email, with submitting authors of accepted articles being offered the opportunity to approve final pdf proofs prior to publication. Where appropriate, authors will be requested to revise manuscripts to meet publication standards.

SUBMISSION PROCESS

All submissions should be sent electronically to 'antenna@royensoc.co.uk', preferably in MS Word format with images sent as separate files (see above). Image captions and figure headings should be included either with the text, or as a separate file.

EDITORIAL BOARD

Editor: Peter Smithers (University of Plymouth)

Editor: David George (Stockbridge Technology Centre)

Editorial Assistant: Jennifer Banfield-Zanin (Stockbridge Technology Centre)

Consulting Editor: Prof Jim Hardie (RES)

Assistant Editor: Adam Hart (University of Gloucestershire)

Royal Entomological Society Postgraduate Forum 2016

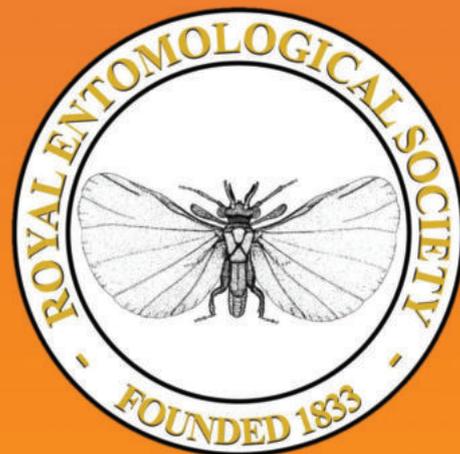
11th—12th February 2016
Harper Adams University

*A two day meeting for early-career postgraduate
researchers in entomology*

To register visit:

www.royensoc.co.uk/meetings

Twitter #RESPG16



Confirmed Speakers:

Professor Simon Leather
Harper Adams university

Dr Amoret Whittaker
University of Winchester

Dr Richard Greatrex
Syngenta Bioline

Dr Sarah Beynon
Dr Beynon's Bug Farm Ltd

Dr Simon Carpenter
Pirbright institute

To submit a talk or poster abstract (<250 words) or for more information, contact Claire Blowers:
cblowers@harper-adams.ac.uk

