Bulletin of the Royal Entomological Society Volume 42 (2) 2018

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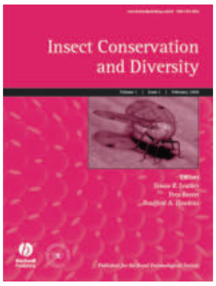

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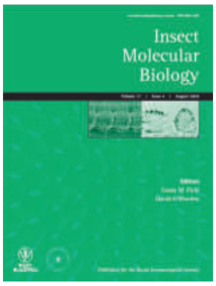

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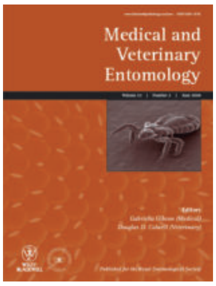

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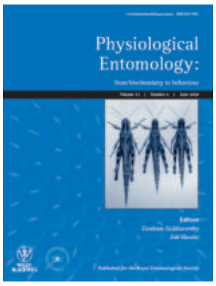

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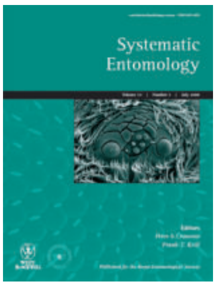

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Stalk-eyed fly (*Achias* sp.)

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EDITORIAL

Hello and welcome to *Antenna* 42(2). As I'm typing this Editorial at the start of April, it's finally beginning to feel a lot more like springtime, with a definite change in the weather apparent here in Yorkshire and many more insects on the wing over the last week or so. Change has also been a feature here at *Antenna* recently, with Issue 1 of 2018 being Peter's last as Editor after many years' service. It's been a pleasure working alongside Peter over the last few years and, although he'll be sorely missed as Editor, it's great news that he'll still be involved in *Antenna* going forward, ensuring that an experienced hand remains at the helm for our traditional Book Reviews section, and also allowing our newly introduced Honorary Fellow Interviews to continue as a regular feature under Peter's authorship. For this issue, he's been to visit regular *Antenna* author, and Assistant Editor, Prof Hugh Loxdale MBE. Hugh's entomology endeavours are first-up in this issue's Society News section, followed by a report on the IBAC 2017 and details of the RES's Student Essay winners for 2017. Spring 2018 also saw the 2017 Wallace Award finalists gather at Mansion House to present and discuss their PhD theses. Although you'll have to wait until the next issue for a taste of the three finalists' projects, all at *Antenna* would like to congratulate Callum Macgregor for his thesis "The role of moths as pollinators, and the effects of environmental change", awarded first place in a very closely contested competition. This issue's Society News also features an update on the RES Library from Val McAtear, as well as our usual 'Schedule of New Members and Fellows'.

With something for everyone, 42(2) includes four articles varying in content from *Ixodes* to insect-plant interactions. We begin our articles section with an offering from John Tennent and David Mitchell on a fascinating (and photogenic – see front cover) group: the stalk-eyed flies. This is followed by a detailed account of Leo Zehntner's contribution to tropical entomology, provided by John and Anita Hollier, including several examples of Zehntner's finely-detailed scientific drawings. We take a relatively rare foray into the Acari for our next article, with Mark Walker providing an interesting account of 'The biology and ecology of the Sheep Tick (*Ixodes ricinus*)' – a species that may already be all too familiar to many a field entomologist, rambler and dog walker. Our final article of the issue is an exotic offering from Peter Cranston on 'Insect-plant interactions in the land of the hornbills' – an especially enthralling read for any ant enthusiasts out there.

In addition to the articles and Society News pieces above, this issue also includes a number of Letters in our Correspondence Section, several obituaries of eminent entomologists who have recently left us, and the usual meetings diary to keep you posted on gatherings of potential interest.

Finally, I'd like to echo Peter in his last Editorial of 42(1) in welcoming Richard Harrington to the *Antenna* team in the position of Editor. Richard will already be well-known to the majority of our readership for his many entomological achievements over the years, and the numerous positions he has held to date within the RES. Although Peter has undoubtedly left some very big shoes to fill, Richard has already hit the ground running, joining the *Antenna* team back in 2017 pre-equipped with many exciting ideas for the future of your quarterly RES Bulletin.

Dave 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

CORRESPONDENCE

Looking for a Lobbyist?

Dear editors

How many ex-entomologist will it take to save the world? I ask as an ex myself, frequently yearning to be back actually involved in the research I read about in *Antenna*.

Instead of following the insect pathway my MSc at Birmingham (in 1989) was supposed to take me on, I somehow fell into the world of agriculture policy and environmental campaigning. I write, I talk, I harangue ministers and I try to change policies to better protect people and planet. But should I, or a more fundamental question, can I go back to research?

I was chairing some sessions at the Oxford Real Farming Conference this January and it was gratifying to hear insects and their role come up again and again. Dung beetles even won the popular vote in a session I organised on what goods public farm payments should support. I cheered even though my pitch lost. The impact of unwise pesticide use on crucial invertebrates is a constant theme in campaigns these days. And you can't read an environmental NGO mailing these days without seeing a cute pollinator. All good really.

Antenna remains my umbilical cord to the academic world alongside Prof Simon Leather's digital musings and in campaign partnerships with NGOs such as Buglife, RSPB and FoE. It's just about enough.

Yet I still miss insect research and wonder if would I make more impact in the field rather than stalking the corridors of power? Does anyone need an assistant with lobbying skills? A genuine question from a lapsed ento...

Yours sincerely,

Vicki Hird MSc FRES
Part time Farm Campaign Coordinator, at Sustain and Independent Campaign Strategy Consultant

The Entomological Skills Gap

Dear Editors,

I would like to respond to John Burton's letter in *Antenna* 41(4) referring to how young people can develop ID skills. The points John makes resonate and we press home similar messages about building their own particular skills to all our Ambios students, many of whom have graduated from, or are undertaking, University courses at undergraduate and postgraduate level in subjects such as ecology and conservation or zoology.

The work Ambios do during student placements or projects can only scratch the surface of the skills required for professional fieldwork, but do provide at least an introduction and can signpost further skills development opportunities. When I talk to our students about the challenges presented by the identification (let alone the ecology) of a number of our UK insect taxonomic groups, the response is often unexpectedly positive. Most of our students are genuinely interested and are not deterred by the specialist keys and many failures to positively ID beyond Family (or to even species in some cases).

On the other hand, we do find there can be an unhelpful reliance on the internet, such as Wikipedia, web images, iSpot (and similar) along with a worrying lack of knowledge of primary sources and experience with keys. I agree with John's comments about joining local groups and societies – this can help but you do need to pick your memberships and activities carefully if you want to connect with the highly knowledgeable field naturalists I knew as a spotty youth.

It is an unfortunate reality that we are losing field skills from the sector as the current generation of professional naturalists retire. Ambios have tried to address this issue in a recent training project supported by Heritage Lottery. Part of that project linked up and coming young naturalists with the older generation, so that taxonomic identification could flow from older to younger participants and technology skills could flow the other way! It has always been apparent to us that, in the current funding landscape for education, such projects are dependent on funding sources such as the National Lottery.

My final point is that with the greater public accessibility of resources such as the plethora of field guides, naturalists handbooks, specialist keys, species image catalogues, comes the need to curate this knowledge so that people with different needs and at different levels know what is the best resource for them, the reliability of the resource, as well as their likelihood of ID success for different purposes. This is not always obvious from the resource itself. Moreover, associated recognition of abilities (including, but not restricted to, qualifications) are part of the key to successful employment in this area. Could the RES be doing more in both these areas?

All the best
Clive Betts

Erratum

In my article "A brief history of the European Congresses of Entomology" published in the special edition of *Antenna* for the 10th European Congress of Entomology held in York, 3-8 August, 2014, I stupidly attached the wrong surname to my Czech colleague mentioned on line 10 below Box 2 on page 9. Anyone familiar with distinguished Czech entomologists will probably have realised that the article should read "Dr Frantisek Sehnal" and not "Dr Frantisek Soldan".

Helmut van Emden
Professor of Horticulture, The University of Reading

Elephant or Privet

Dear Editor,

I am grateful to Richard Revels for pointing out to me an apparent error in my article 'Gilbert White the entomologist', which appeared in *Antenna* 41 (4). On page 182 I confidently suggested that the 'vast insect *Sphinx forte ocillata*' that White saw in his garden on 29 June 1776 was an Eyed Hawkmoth *Smerinthus ocellata*. As I should have known from my long familiarity with this species, the adult moth is unable to feed from honeysuckle, or any other flowers, as it has a much reduced proboscis. The question therefore remains as to what species it was that White saw? Richard Revels suggests an Elephant Hawkmoth *Deilephila elpenor*, which is on the wing in June and July and regularly nectars from honeysuckle, and, although not as large as an Eyed Hawkmoth and lacking eyespots, may have appeared 'vast' to him in the darkness. Richard also suggests the possibility, which had also occurred to me, of it having been a Privet Hawkmoth *Sphinx ligustri*, which certainly could be called vast and is also on the wing in June and July.

Yours faithfully
John F. Burton

The eyes have it!
The eyes have it!

But how, if that fly had a father and mother?
How would he hang his slender gilded wings,
And buzz lamenting doings in the air!
Poor harmless fly,
That, with his pretty buzzing melody,
Came here to make us merry! and thou hast kill'd him.

Shakespeare
Titus Andronicus
Act 3, Scene 2

Figure 1. The summit of 'Oiatabu on a typical day – cold, wet and miserable.

Figure 2. *Achias* sp.

W. John Tennent [1,2]
& David Mitchell [3]

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[3] Director, Eco Custodian Advocates (NGO), Alotau, Milne Bay Province, Papua New Guinea

Long periods of tropical fieldwork inevitably result in observation of dozens of species of insects in taxonomic groups far removed from one's own knowledge or experience, and one often wonders if a peculiar looking ant, or a brightly coloured bee might be something no-one has ever seen before. Such thoughts usually remain unresolved – colleagues have often asked for specimens of various things "if you happen to see any …" – but concentration is needed for the job in hand, and distractions are … well … distractions.

But just occasionally, you see something so bizarre it's hard to ignore. A "what on earth is that?" moment. In the final part of the first author's 10 year research into the diversity of butterflies on the Milne Bay Province islands in Papua New Guinea, the authors spent several weeks in 2015-17 climbing to the summit of several high mountains of islands in the D'Entrecasteaux group and Louisiade Archipelago, camping for several days and nights on the summits of a number of peaks, often under less than ideal conditions which kept us confined to our tents. Since there are no tracks at high elevations, we usually had to be cut through the forest, and at times when the forest was left behind in favour of extensive grasslands or bare rock, the going was particularly difficult: not only because the way became steep and slippery, but because there was no respite from an unrelenting sun.

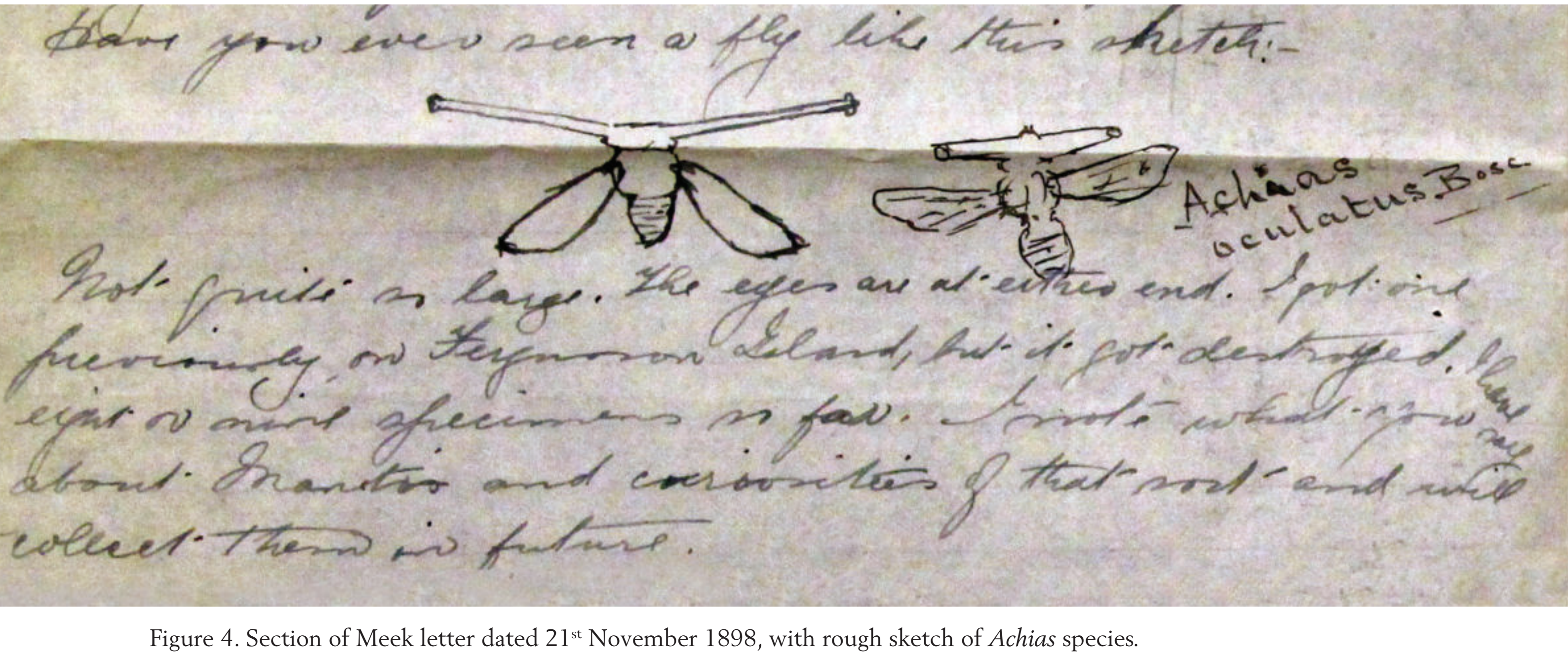
In October 2016 we reached the 1,800 metre peak of 'Oiatabu (Mount Kilkerran) on Fergusson Island, the central of the three main islands of the D'Entrecasteaux group, each of which has peaks higher than 1,000 metres. The summit of 'Oiatabu (Fig. 1) was a small, not particularly flat area barely wide enough to pitch tents, with a sheer drop and magnificent view west to Goodenough Island, and north to the scattered Amphlett islands. We stayed there for six nights. Thankfully, the peak was sheltered on the eastern side by the tangled upper branches of trees, the roots of which roots were further down the steep slope, and this allowed growth of rough grass on much of the summit plateau. The weather was atrocious for much of our stay, with what seemed like hurricane force winds, invariably accompanied by driving rain. But on the infrequent occasions when the sun came out, and even fewer times when the wind calmed down, collecting was possible.

On one such morning, we experienced a "what on earth is that?" moment! Sitting in the open on a broad leaf of grass was a fly about the size of a blue bottle, which had the most peculiar extensions on either side of its head: a 'stalk-eyed fly' (cover image and Fig. 2).

Figure 3. *Achias* sp., summit of ‘Oiatabu (Mount Kilkerran), Fergusson Island, Papua New Guinea, collected in October 2016.

The first author is preparing a biography of Albert Stewart Meek, one of Rothschild’s most prolific collectors for his private museum at Tring in the late 19th and early 20th centuries, and remembered a note and rough sketch of such a creature in one of Meek’s letters to Tring, now in the archive of the Natural History Museum in London. Over several days, we saw a total of four stalk-eyed flies, and managed to catch three of them (Fig. 3). The first fly was sitting on a leaf, but it must be admitted that the others were seen feasting rather disgustingly – and those about to sit down for Sunday lunch may want to skip this bit – on the contents of our newly-dug toilet at the edge of the clearing inside the moss forest. We made several significant discoveries on the top of the mountain, but were unsurprisingly pleased above all with the stalk-eyed flies, which neither of us had ever seen before in our long periods in the field.

A. S. Meek was also taken with this strange fly. In a letter written to natural history dealer Oliver Janson, on the 21st of November 1898 (Fig. 4) from his base on the Papua New Guinea island of Samarai, Meek asked: “Have you ever seen a fly like this sketch:- Not quite as large. The eyes are at either end. I got one previously on Fergusson Island, but it got destroyed.”. Following the first line, there is a crude sketch of a stalk-eyed fly, its eyes on the extremities of long, slim stalks; a second sketch depicting a fly with shorter and more compact stalks, which is annotated “Achias oculatus Bosc.”, is slightly less



Have you ever seen a fly like this sketch:-

Achias oculatus Bosc.

Not quite as large. The eyes are at either end. I got one previously on Fergusson Island, but it got destroyed. I have eight or nine specimens so far. I note what you say about Mantis and curiosities of that sort and will collect them in future.

Figure 4. Section of Meek letter dated 21st November 1898, with rough sketch of *Achias* species.

crudely drawn than the first – it is taken to have been drawn by a different hand for this reason – and because Meek said “this sketch” rather than “these sketches”, although when magnified, it does appear that the “th” of the word “either” may have been written over the abdomen, rather than the reverse. Whilst not clear whether Meek himself added this second sketch after he had finished the letter (it was not unusual for him to write a letter over several days or even weeks), the name *Achias oculatus* was almost certainly added later, since Meek declared he had no idea what the fly was.

Janson couldn’t help with identification and replied to Meek in a letter dated the 3rd of February 1899: “The fly of which you send a sketch is either one well known to me or very closely allied to it. I have had specimens from New Guinea and some of the other islands in the Moluccas. I forget its name for the moment …”.

The flies Meek refers to in his letter are those of the family Platystomatidae which includes the genus *Achias* – stalk-eyed flies. In 1898, at the time Meek wrote this letter, only a dozen or so species of *Achias* were known, most of these described by Francis Walker from material collected by Alfred Wallace in the late 1850s. *Achias oculatus* is the type-species of the genus *Achias*. Now nearly 100 species have been described, 67 of these in a revision published by Australian specialist David McAlpine (McAlpine, 1994), including *A. meeki*, collected by Meek in the Aroa River district on the New Guinea mainland. There is insufficient detail in Meek’s sketch to accurately identify the species, but it could be *A. rothschildi*, which has the “widest” stalks of any species and which it seems to resemble quite closely; a Fergusson specimen collected by Meek was noted by John Russell Malloch (1939) and it was thought “our” specimens probably belonged to that same species. Pictures were sent to David McAlpine in the Australian Museum, Sydney, in the hope of confirming identification. He was of the opinion that the specimens did not conform to any described species. They are at present with a Diptera specialist in Australia, David Hancock.

And the point of this short note? Not to tell the world how smart we are for the discovery. But to illustrate, especially to young people, that despite the unrelenting doom and gloom on our screens every day, and difficulties in getting funding, and the awfulness of much of the world we have constructed for ourselves, there remain plenty of interesting unexplored places with many new things just waiting to be discovered. So – get on your hind legs. Make a plan. Do it!

Acknowledgements

Thanks to Dan Bickel for facilitating contact with David McAlpine; to David Hancock, Cairns, David McAlpine, Australian Museum, Sydney, and Nigel Wyatt, Natural History Museum, London for discussions on *Achias*; NHM archivists and Harriet Campbell-Longley for enabling access to the Janson family archives; and to the Trustees of the Natural History Museum for allowing reproduction of Meek’s letter.

The first author is grateful to the National Research Institute, the Conservation and Environmental Protection Authority (formerly Department of Environment and Conservation), Papua New Guinea National Government, and the Provincial Research Committee, Milne Bay Provincial Government, for supporting butterfly research in Milne Bay Province. Funding for 2016-17 fieldwork was provided by the Natural History Museum, London (Special Funds); the Royal Entomological Society; The Percy Sladen Exploration Fund, London (Linnean Society); Australian Geographic Society, Sydney; Normanby Charitable Trust, London; and Lady Alice Renton, East Sussex, UK. Particular thanks are due to Martin Jacoby, Somerset, UK, who continues to provide the first author with substantial support in word and deed.

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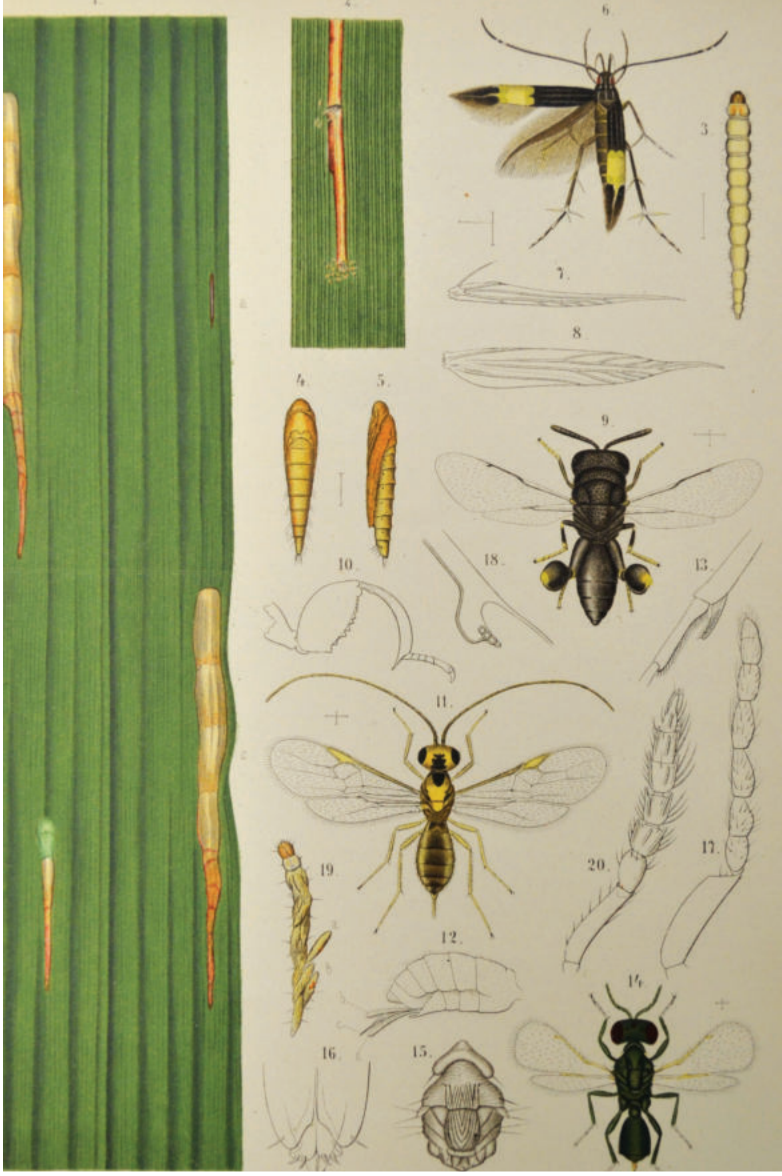
McAlpine, D. K., 1994. Review of the species of *Achias* (Diptera: Platystomidae). *Invertebrate Taxonomy*, 8 : 117-281.

The parasitoid *Encarsia tristis* (Zehntner) and its whitefly host.



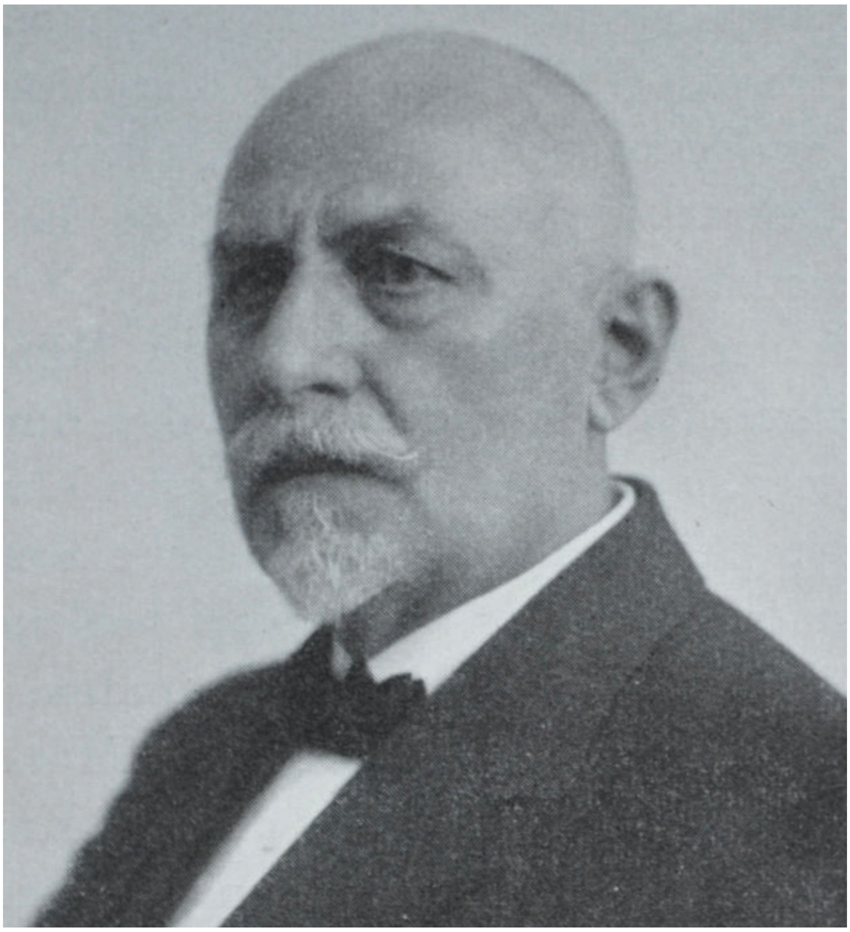
The leaf miner *Cosmopteryx pallifasciella* (Snellen) and its parasitoids.

Leo Zehntner, Swiss pioneer of tropical applied entomology

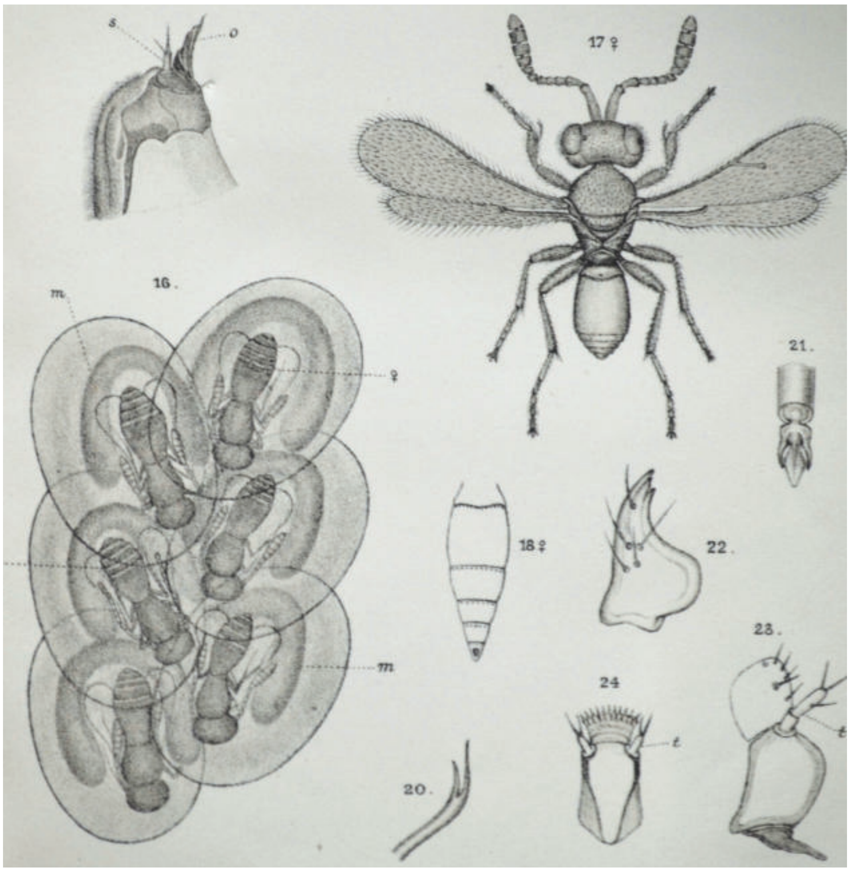
John Hollier & Anita Hollier

Muséum d'histoire naturelle de Genève, C.P. 6434, CH-1211 Genève 6, Switzerland

Leo Zehntner (1864-1961) was born in Reigoldswil in the half-canton of Baselland, Switzerland, the son of a doctor. Zehntner studied natural sciences in Basel and Bern, being awarded a teaching qualification in 1888 and a doctorate in 1890. Recommended by his old professor Theophil Studer, he was quickly engaged as a technician at the Geneva Natural History Museum, where, by his own account, he worked mainly as assistant to Henri de Saussure (Zehntner, 1954). Saussure was a prolific taxonomist who studied many taxonomic groups and described over 3,000 species (Hollier & Hollier, 2013), and was therefore an ideal mentor for the talented young zoologist. As well as working on the Geneva Museum collections, Zehntner assisted Saussure with projects on the fauna of Madagascar for Grandidier (Paris) and Voeltzkow (Frankfurt), the orthopteroid insects of Central America for the *Biologia Centrali-Americana* of Godman and Salvin (London) and the Orthoptera of India for the Calcutta Museum (although the latter was never completed). Unusually for the period, Saussure made Zehntner co-author of the publications on Myriapoda, Blattodea and Mantodea relating to these projects, and of revisions of several groups of Blattodea and Orthoptera. This was no patronising gesture however; Zehntner was an accomplished draftsman and



Leo Zehntner.



Egg parasitoid (detail)

had an eye for taxonomic detail (Hauser, 1972), and while Saussure provided the systematic overview it was Zehntner who made the drawings of microscopic preparations and helped prepare the plates (according to Saussure himself in the preface to Humbert, 1893). Zehntner also published a solo paper on the crustaceans that had been collected by a Geneva Museum expedition to the Moluccas (Zehntner, 1894).

In 1894 he took up a post under J. H. Wakker at the Sugarcane Research Station at Pasuruan in Java (Proefstation Oost-Java), then part of the Dutch East Indies. At this time Java was the most industrialised sugar producing region in the world, and many innovations originated here (Ruskanda & Ridwan, 1994). Funded by the sugar industry in response to the spread of the sereh disease virus, the Java research stations at Semarang (set up in 1885), Tegal (1886) and Pasuruan (1887) were encouraged to do "blue sky" research on plant breeding and pest control (Mutsaers, 2007) and published lavishly illustrated reports (Howard, 1930). The value of this approach was best revealed by the unveiling at Pasuruan of the mosaic-virus resistant sugarcane variety POJ 2878 in 1921, a variety which dominated sugarcane production worldwide by the late 1920s, continued to be planted up until the 1960s in some regions, and is one of the ancestors of most of the currently cultivated varieties (Mutsaers, 2007).

At Pasuruan Zehntner studied the animal pests of sugarcane, primarily insects, and their parasitoids, as a complement to the work on diseases. The most important pests were leaf- and stem-boring Lepidoptera, but Zehntner also discussed coccids and aphids as well as other less host-specific pests. Many of the species he encountered were described as new to science, and Howard (1930) was struck by how accurately he worked, given that he was based in provincial Java, far from libraries and museum collections: most of the species he described are still recognised as valid. Because the publications were intended to contribute to practical cultivation Zehntner also gave descriptions of known species, which occasionally resulted in confusion (Hollier & Willemse, in press). Since sugarcane is a crop grown throughout the tropics Zehntner had a wide correspondence

Syntypes of *Centophasma zehntneri* (Carl) collected by Zehntner in Sri Lanka.

Sugar cane with scale insects brough to Geneva by Zehntner

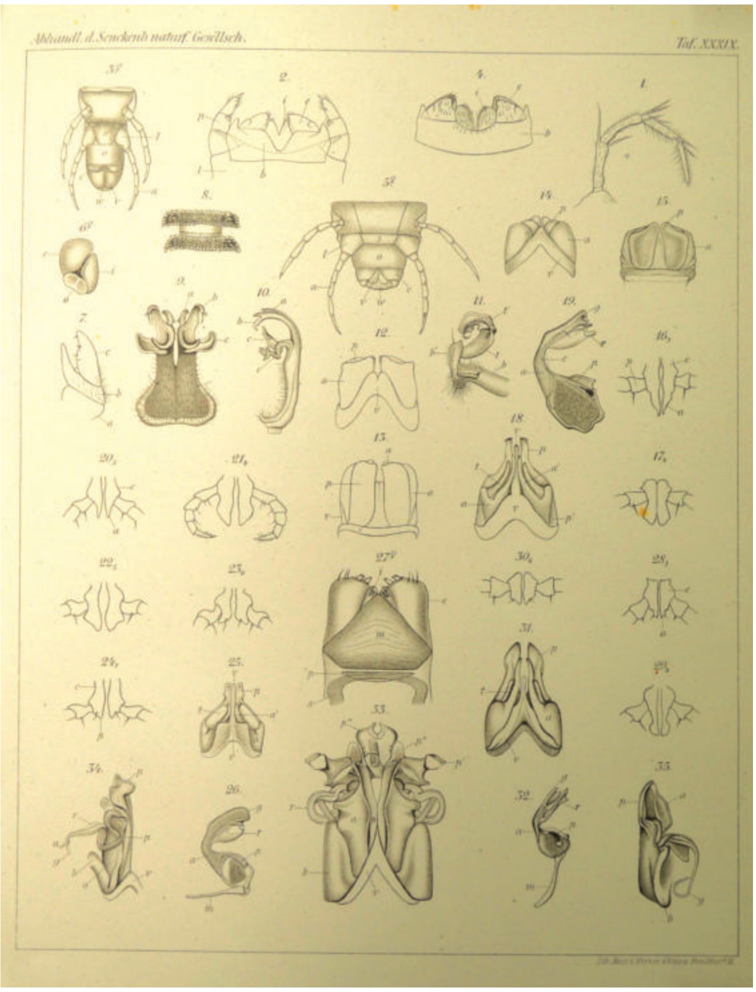
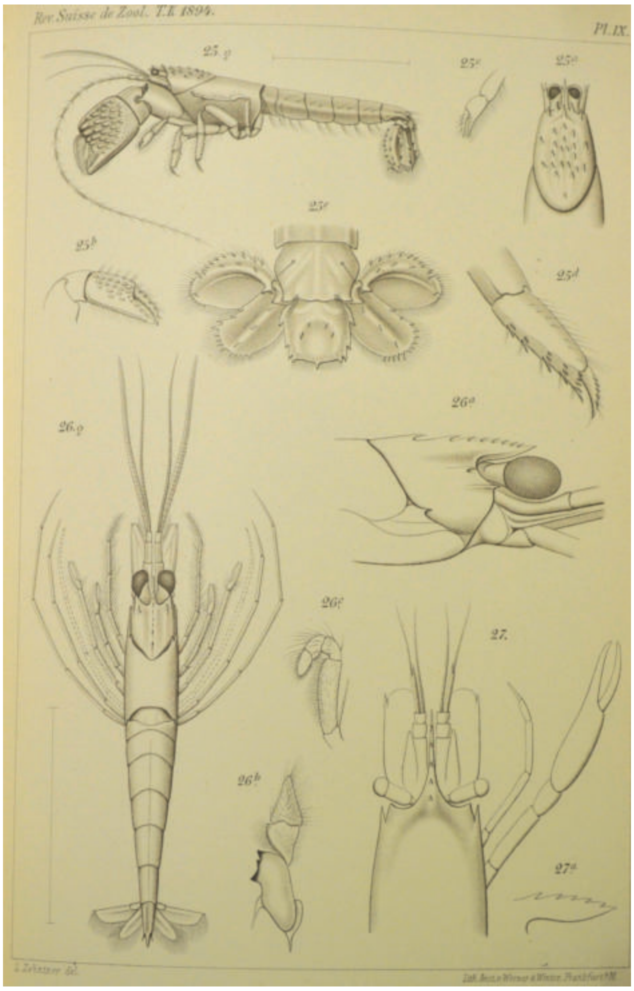


Plate with details of Myriapoda of Madagascar.



Crustacea from the Molucca Islands described by Zehntner.

The scale insect *Odonaspis saccharicaulis* (Zehntner).

The scale insect *Aulacapsis madiunensis* (Zehntner) and its parastioides.

and a summary of his work on the most important borers appeared in English as early as 1898. A note by the editor of the volume in which it appeared stated that Zehntner had written the English summary himself, indicating considerable linguistic flexibility (he already had scientific publications written in French and Dutch, as well as his native German). While he was in Java Zehntner sent many specimens back to European museums. The Geneva Museum gained many specimens in this way, and a number of species were dedicated to him as their discoverer.

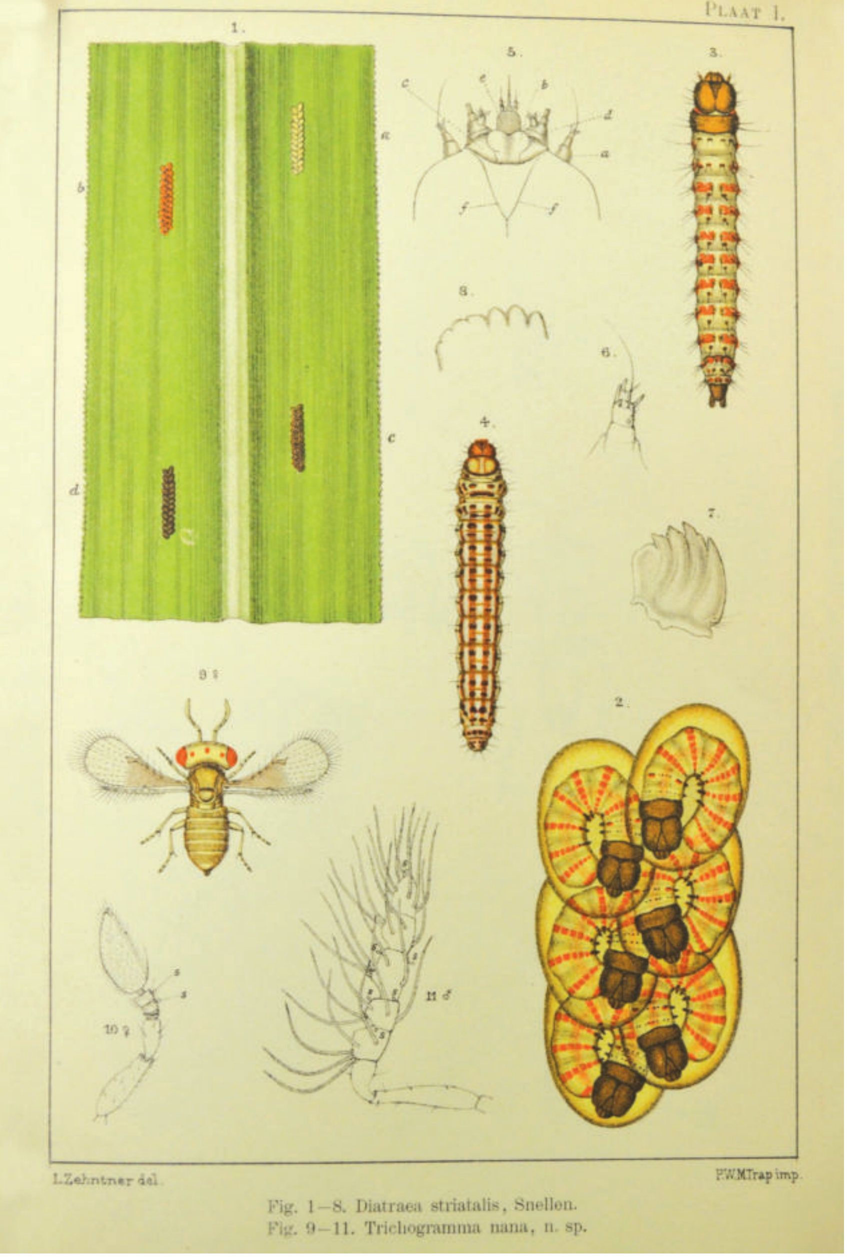
In 1900 Zehntner returned to Europe where he spent another six months working for Saussure, this time apparently at the latter's expense rather than as a museum employee. This period was probably spent on finishing their work on the Myriapoda of Madagascar (see Hollier & Wesener, 2017).

In 1901 Zehntner returned to Java to help establish a Research Centre for Cocoa cultivation at Salatiga. This Station was destroyed by fire the following year along with his insect collections and unpublished notes and drawings. Undeterred, he borrowed equipment from the botanical gardens at Buitenzorg (now Bogor) and started again. By 1905 he had five Europeans and eight locals working for him, and the scope of the work had broadened from cocoa to general applied entomology, with notable studies on indigo and cinchona (Zehntner, 1954).

Zehntner was extremely productive while in Java; he published 31 papers on the pests and cultivation of Sugarcane (three of which were summaries of his findings in translation) based on his work at Pasuruan, and 20 papers on the pests and cultivation of cocoa, coffee and other crops based on his work at Salatiga. Another 11 publications dealt with other biological observations made in Java.

Among the early visitors to Salatiga was Miguel Calmon, head of the Bahia State Department of Agriculture in Brazil. Calmon was making a study tour of research facilities in Egypt, India, Sumatra and Java with the intention of founding an agricultural research institution in his home country. He had already seen Zehntner's publications, and was so impressed with the organisation at Salatiga that he offered him the post of director there and then. Zehntner was still struggling to put the station on its feet after the fire and did not feel he could leave at that time, but the offer was held open, and in 1906, when he was assured that Salatiga was a success, he left for Brazil. Zehntner stopped in Sri Lanka on the way back to Europe; perhaps he was partly motivated to visit the island because of the expedition of Aloïs Humbert, the first curator of the Geneva Museum, a trip that resonated in the museum's history (Hauser, 1972). Some of the specimens he collected there were deposited in the Geneva Museum while again breaking his journey in Europe.

In Brazil, Zehntner was given the premises of the old Imperial Agricultural School at São Bento das Lages as the headquarters of the Bahia Agricultural Institute and set about adapting it for its new functions by having new crops planted alongside the single existing orchard. He soon discovered that the land was less than



The leaf miner *Chilo sacchariphagus* Bojer (referred to by Zehntner with the junior synonym *Diatraea striatalis* Stellen) and its parasitoid.

ideal for the purpose, being rocky and with brackish water. He also found that the buildings had not been properly maintained and were unfit for research or accommodation. The State government could not provide sufficient funding and passed the responsibility to the Federal Government, leading Zehntner to resign as director of the Institute in 1910.

Having had little time for entomology because of his administrative responsibilities, and finding that insect pests were apparently less destructive in Bahia than in Java, Zehntner turned his attention to applied botany and published studies on cocoa and cassava cultivation in Bahia. The Ministry of Agriculture proved uninterested in his ideas, however, so he started exploring the interior of the state, investigating cotton and rubber cultivation. He also worked occasionally for a company extracting sisal hemp from agave. He then spent a few years doing large-scale experiments in dry farming systems, using eucalyptus with good results. While based at this plantation he was able to make a number of botanical expeditions, and discovered several new plant species and many new varieties of cassava. Although he published relatively few works in Brazil, those he did included extensive monographs and he added Portuguese to his linguistic repertoire. In 1920 he retired, and returned to Switzerland. Despite the difficulties, he considered his years in Brazil as his most enjoyable (Zehntner, 1954).

In 1922 he returned to his native Reigoldswil, where he was known as "The Brazilian", and of which he was mayor from 1926 to 1941. He was elected to the cantonal parliament, served on the education board of the canton and was a founder of the Baselland Museum Society. He was active in the cantonal natural history society and nature conservation groups until his final years, and gave his last presentation, about the horns of the kudu, at the age of 94. Leo Zehntner died in 1961. His scientific publications are listed in Schassmann (1942) with supplements by the same author (1961) and Hauser (1972).

We are very grateful to Bernd Hauser for many valuable discussions about the history of the Geneva Museum and his comments on the text.

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Questing by *I. ricinus* adult. Image courtesy of ECDC: Guy Hendrickx.

The biology and ecology of the Sheep Tick (*Ixodes ricinus*)

Mark Walker

Mark David Walker is a parasite biologist based in Sheffield. He studied parasitic Louse-flies of Common Swifts for many years.

Introduction

If you are an enthusiastic countryside user, you have unfortunately probably had first-hand experience of the Sheep Tick, *Ixodes ricinus* (Linnaeus 1758). Typically, the characteristic small raised bump, often found around the groin, is discovered only while taking a post walk shower. Closer examination reveals a feeding tick with its mouthparts deeply embedded. Although this might not endear ticks to the wildlife lover, these invertebrates have a fascinating life-history and a suite of superb adaptions, making them well suited to their parasitic life. Recent research has revealed much detail about both.

The name of the Sheep Tick is misleading, it being polyphagous and happy to parasitize a wide range of hosts; mammals, birds and even lizards (Piesman and Gern 2004). Its lack of fussiness helps account for its wide distribution and abundance. The Sheep Tick is the most abundant British tick (Abdullah et al. 2016). The alternative name of the Castor Bean Tick is also rather inappropriate; the tick has nothing to do with the Castor-Oil plant (*Ricinus communis*), merely being thought to resemble the seeds in shape. A much better common name would be the 'Bush Tick', as it is mostly found in dense undergrowth.

Ticks are blood feeding ectoparasites. There are seven orders within the Subclass Acari, of which the ticks form one; the Ixodida (Beccaloni 2009). This is divided into three families; the Ixodidae or 'hard' ticks with 900 species, the Argasidae 'soft ticks' with 200 species, and the rather unusual Nutalliellidae – represented by a single species. 'Hard' ticks possess a tough outer protective layer known as a 'scutum'; the Sheep Tick is a fairly typical example. In Britain there are 24 species of tick, most belonging to the Ixodidae (NHM 2017). However, the chances of coming across most is small, as they generally specialise on specific types of host. Some are exclusively bird parasites, such as the Passerine Tick (*I.*

Figure 1. Dorsal view of *I. ricinus* excellently showing segmented legs, dorsal shield 'scutum' and mouthparts. Courtesy of Chris Moody.

Figure 2. Image of *I. ricinus* showing flattened profile. Courtesy of Chris Moody with permission.

frontalis) or the Seabird Tick (*I. uriae*). Others are primarily nest based, such as the Hedgehog Tick (*I. hexagonus)* (Pfäffle et al. 2011), and are thus unlikely to be encountered by those not specifically seeking them.

Physical Description

The Sheep Tick is a fairly typical *Ixodes* tick. Figure 1 shows the typical ovoid or pear shape body. Sheep Ticks have a rich brownish red colour, but when engorged with blood the female abdomen becomes a light grey. Figure 2 shows the flattened profile when unengorged; this allows ticks to delve close to the skin of hosts between feathers and fur directly to the source of blood. In size adult males may be 2.5 to 3 mm long, females are larger being 3 to 4 mm long. However, this is when unfed; when engorged females can exceed 1 cm in size. Pictures of engorged ticks abound and show the truly horrendously enlarged state of the females when fully fed.

Morphologically, ticks can be divided into three sections; the head, the body and the legs (Beccaloni 2009).

Head: The head and mouthparts are called the 'Capitulum'. At the base is a squarish structure known as the 'Basis Capitulum', this being basically a support structure for the mouthparts. The 'Auriculae', small spurs jutting from its side, are important species identification features. In Sheep Ticks they are dark divergent triangles (Hillyard 1996). Other species have cornea on the basis capitulum, but these are absent in *Ixodes ricinus*. The mouthparts feature a number of structures used in feeding, including sensory 'palps', cutting structures known as 'chelicerae', and a syringe like 'hypostome' used to remove blood.

The body: Technically the frontal region of mites is known as the podosoma and the posterior as the opithosma (Beccaloni 2009). However, in ticks these sections are indistinct and have merged together. Figure 1 shows the dorsal view. Notable is the shield like 'Scutum', a hard chitinous covering offering protection. This covers the entire body in males, but in females only provides a partial covering. Females take large blood meals and this incomplete covering allows the rest of the body to enlarge; this would not be possible with a complete hard covering. Indentations running down the scutum are known as scapular grooves, while

Figure 3: Larval *I. ricinus* showing their small size by comparison to the leaf on which they are sited. Courtesy of ECDC: Guy Hendrickx

those running around the rim are known as lateral grooves (Arthur 1963). In some ticks the lateral groove divides into sections known as 'Festoons', but these are not present in the Sheep Tick.

Ventrally, the genital opening is found between the 3rd and 4th pair of legs. In the males there are also several harder plates; these occur around the genitals and anus. A useful identification feature is that the anus is surrounded by a groove (Arthur 1963).

Legs: The legs are best observed ventrally. They are attached to the frontal podosoma region. The four pairs, all segmented, are numbered from front to back I to IV. The final end segment is known as the tarsus, and in the Sheep Tick the tarsus of the first leg (Coxa I) is long and tapering. 'Spurs' are a frequently used feature to differentiate between different ticks species, these being distinct sharp hooks protruding from the legs and probably aiding attachment to hosts. They are to be seen on the first coxal segment, closest to the body. Sheep Ticks have long spurs on the first coxa - so long that they overlap the adjoining segment on the second leg pair. Spurs on the other coxa are either absent or indistinct.

Life cycle

Sheep Ticks progress through a number of life stages before reaching maturity, a blood meal being needed to progress to each developmental stage post-hactching. Eggs hatch into larvae, which moult into immature nymphs, which in turn moult into fully sexually mature adults. Sheep ticks are 3-host ticks, seeking out different hosts at each developmental stage.

Larva: Larvae hatch about eight weeks after being laid as eggs. They are small – only 0.8 mm long – and unlike other life stages they have only 3 leg pairs. Typically, larvae feed on small mammals, such as mice or voles (Kurtenbach et al. 1995). If no potential hosts are encountered post-hatching, larvae may overwinter and continue development the following spring.

Nymphs: Once fed, larvae drop into vegetation and moult into nymphs. Nymphs are essentially adult ticks, but are sexually immature and lack genital openings. They are typically 1.4 mm long. After moulting a new host is sought, typically a larger mammal such as a deer, sheep or cow. Nymphs are widely scattered in the environment, having been widely distributed by the larval hosts. After another feeding bout, nymphs fall into vegetation to moult into adults.

Adults: Once they have moulted into adults, Sheep Ticks seek out a further, final host. Reproduction is the goal here, with mating occurring on this host. Females take substantial blood meals to enable large clutches of eggs to be laid. Adult males may not feed at all; instead their main task is to locate females and mate. Pheromones allow males to detect females and they often travel large distances over the host to do so. Mating may take over a week, with males attaching to a female while she feeds. Females then drop off into vegetation and begin to lay eggs. They can be highly fecund, laying over 2,000 eggs over 4 to 6 weeks, covered in a waxy secretion which aids their survival and protects against desiccation.

The whole life cycle is somewhat protracted, as successfully locating a suitable host can take time, and Sheep ticks have to do so three times. A life cycle can be completed in 18 months, but 3 to 5 years is probably more typical (MacLeod 1935). Presumably many ticks fail to find hosts and thus perish. Only a few weeks of the entire tick life is actually spent on the host.

Questing and Resting

'Questing' involves little activity; ticks simply wait for passing hosts. British tick expert Jolyon Medlock has called it an 'ambush technique' (Medlock et al. 2013). There are special sensory cells on the front legs known as 'Haller's Organs' which detect host carbon dioxide and heat. The legs are held outward in a characteristic stance helping expose these cells to passing host cues. Larval ticks, which as already noted preferentially parasitise small mammals, have been found to 'quest' mostly in lower levels of vegetation, near ground level, where these hosts are more likely to be encountered (Mejlon & Jaenson 1997). Nymphal and adult ticks instead climb vegetation to higher levels to increase their chances of detecting larger hosts such as deer.

Ticks do not constantly 'quest'; instead they alternate between questing in high vegetation and returning to the lower undergrowth (Belozerov 1982). This behaviour is driven by the fact that ticks are very sensitive to desiccation, the risk of which is increased when they are perched high on vegetation, exposed to sunlight. Water is lost through their cuticle and the breathing spiracles which are open when they move around. Thus, ticks must periodically return to lower levels to rehydrate (Milne 1948). Such constant 'shuttling' can use precious energy, and ticks only have limited supplies to fuel this activity between bloodmeals. Ticks enter diapause during winter, which is mediated by day length (Belozerov 1982), becoming active again in the spring, triggered by rising temperatures (Perret et al. 2000).

Feeding

Mealtimes are a serious business. Adult females feed for over a week. But then ticks feed only a few times in their lifespan so it pays to get it right! When on the host, ticks seek out body parts where blood can be easily withdrawn. In many mammals the head and areas around the ears are favoured, with children often being bitten on the head and neck. In adult humans, however, the groin or the breasts are preferred (Berglund 2005).

Ensuring a firm attachment is essential for long-term feeding. Dania Richter and colleagues, from the University of Tübingen in Germany, have recently conducted research using close-up cinematography to reveal the processes involved in initiating feeding (Richter et al. 2013). 'The meaning of the word 'Palps' is to feel' explains Dr. Richter, 'and this is what ticks effectively use them for'. The chelicerae are used like a ratchet; first piercing the skin, moving alternately to gain a firm attachment, then moving in sync to pull the hypostome into the skin. 'The chelicerae also have sensory pits allowing ticks to feel what they are doing' notes Dr. Richter, 'they allow the ticks to gain a foothold on the host. They actively search for a site where they insert their mouthparts. But differently from mosquitoes, they do not need to hit a blood vessel, because ticks are pool feeders.'

On initiation of feeding, salivary material containing anticoagulants and painkillers are injected into the host. This cocktail also contains substances that suppress the host's immune system and inhibit a T-cell response (Willadesn and Jongjan 1999). It is within this salivary fluid that bacterial pathogens such as *Babesia* and *Borrelia* are found, and these may be passed to the host during feeding. Feeding does not commence immediately on attachment, however, where typically a tick is attached for over 12 hours before salivary material is pumped into the host and blood is removed.

Distribution

Sheep Ticks are found throughout Britain. Martyn (1988) and Pieztch et al. (2005) mapped records submitted to the Biological Records Center and found this species was widespread throughout England, Scotland and Wales. Relatively recent surveying of landowners suggests that they are becoming more abundant (Scharlemann 2008), possibly increasing in range by 17 percent, and in local abundance by 73 percent.

Tick distribution and abundance can be studied by collating numbers seen on domestic pets. In these 'sentinel' studies dogs and cats more effectively survey thick vegetation than any biologist could. Such studies provide an ideal method to investigate the risk of contracting a tick bite, and as Swaid Abdullah of Bristol University notes, 'the UK has a large dog population with 1.3 dogs per household. These dogs are walked everyday in various habitats and visit veterinary practices regularly'. As a result, pets provide an ideal large population, active in the countryside, to sample tick populations. 'Since humans always accompany these animals and often share the same green spaces as their pets, the level of tick bites pets receive could serve as good indicators of tick bite risks and also risk of catching tick borne diseases in man.'

Swaid's work involved over 12,000 dogs, from which were found 5,236 Sheep Ticks, making this species the most frequently seen tick, accounting for 89 percent of all ticks combined (Abdullah et al. 2016). Sheep Tick abundance was particularly high in the south in this study, perhaps because this was where most dogs and dog owners were located, but more probably because southern areas are generally warmer. Despite *Ixodes ricinus* being found throughout Britain in this work, however, Swaid Abdullah warns that 'the distribution map shows presence, but not prevalence. The relative risk map is a better guide for the risk of tick bites. This indicates that Scotland and northern East Anglia are at higher risk of tick bites.'

Habitat

Ticks favour wooded and semi wooded areas. They are particularly associated with scrubby secondary habitats, woodland edges, and areas of unkempt grassland. Boyard et al. (2008) compared the abundance of ticks on rodents in grassland, hedgerow and woodland, finding most in woodland and fewest in pasture. Tack et al. (2012) compared tick populations in oak and pine stands, finding greater abundances of all life stages in oak, probably because this habitat had a thicker understorey, better suited to tick survival. Dobson et al. (2011) cites ticks as being more abundant in habitats containing trees *per se*, and in support Ogden et al. (2000) reported that dogs and cats were more likely to be infested in wooded areas. Such habitats probably offer thick layers of vegetation that are able to keep ticks well hydrated. This could also explain why, in a classic study, Milne (1944) found that Sheep Ticks were more abundant on undrained pasture with long grass.

Many studies have found that ticks are most abundant in high summer. Gassner et al. (2013), for example, found peak densities in July and August, though the population structure is complex and varies depending on location. Typically tick abundance may more generally peak in late spring and early summer when overwintering nymphs and adults become active (Dobson et al. 2011).

The role of host dynamics in tick survival

Hosts play a vital part in maintaining tick numbers. Small mammals need to be present to sustain larval populations. Kurtenbach et al. (1995) found that nearly 98 percent of ticks on small rodents were larvae. Larger mammals are important for sustaining later stages, such as nymphs and adults. Gower et al. (2008) showed that ticks occurred in abundance on grassland where livestock hosts were available, but not on nearby woodland where deer were absent. Another recent study has found that the abundance of Sheep Ticks was lower in fenced areas than those that were unfenced and allowing deer to roam freely (Ruiz-Fons and Gilbert 2011).

Ticks appear to be becoming more abundant. Possibly because deer are now more widespread than previously (Walker 2015), and potentially because countryside management emphasises thick vegetation understoreys to enhance biodiversity. However, climate warming may be the most important driving factor behind increasing population levels. In Scandinavia, for example, ticks are known to be spreading northwards due to warmer temperatures (Jore et al. 2014). Ticks are already present in Scotland, but currently only at relatively low altitudes below 700 metres. Warmer temperatures are likely to result in ticks occurring at higher elevations (Medlock and Leach 2015). Winter weather conditions may be especially important and can greatly affect tick distributions, where our generally warmer winters and earlier springs may be favouring tick survival (Lindgren 2006). Thus, if you are an enthusiastic countryside user, or one of our many dogs and cats, the cold and late spring of 2018 may have had its upside!

Acknowledgements

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Insect-plant interactions in the land of the hornbills

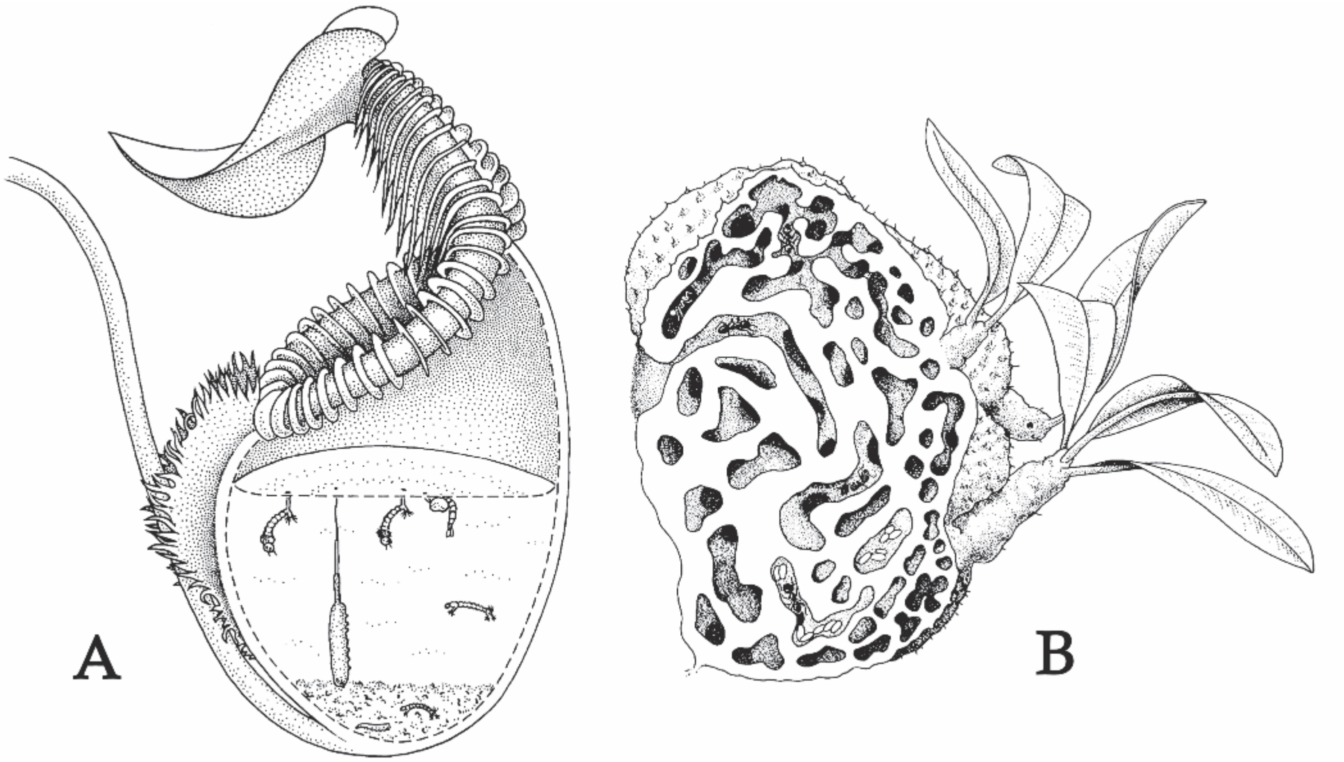

Figure 1. Stylised cross-sections of: A, Pitcher of *Nepenthes*; B, 'Tuber' of epiphytic myrmecophytic *Myrmecodia*. Illustrations by Karina McInnes from Gullan & Cranston (2014).

Peter Cranston

Sarawak, one the two Malaysian states in the north-west of the island of Borneo, has much to offer a traveller interested in cultural and natural history. British interest stemmed from the role of the Brooke family in governing the land following a military intervention that saved the sultanate of Brunei. The white rajahs, as the family dynasty became known, ruled an expanding Sarawak with minimal intervention, paternally for sure, with community power shared between Chinese, Malays and well-respected native Iban and other Dayak and indigenous peoples. Historic head-hunting was redirected (mostly) into the formal militia. This usually harmonious multiculturalism has survived to the present, exemplified by cuisine, religions, division of work, land management and in retention of old and construction of new buildings with cultural sensitivity. The indigenous longhouses are less evident along the river banks than 30 years ago, but many sensitive replacements use concrete pads and incongruously bright blue colorbond (steel) in place of wobbly decking and shingle roofing from bush materials. Many young Iban have moved to cities, but a longhouse culture is by no means extinct.

For a biologist seeking the charismatic fauna, sightings of orangutans, proboscis monkeys and diverse hornbills remain possible, as do views of the impressive Rajah Brooke's birdwing butterfly (*Trogonoptera brookiana*). However, the well-documented mega-expansion of oil palm plantations and continued logging, with loss of primary forest, restricts most sightings to natural reserve systems. High quality biological research continues in some of these reserves, notably Gunung Mulu, where a Royal Geographic Society Expedition in 1977-8 involved several entomologists from the UK, and Lambir Hills, where international entomological studies take place in and around a long-term Forest Dynamics Plot.

Two national parks within an hour of Kuching (the capital) are Bako on the coast and Kubah in lowland to higher elevation forest around Gunung (Mount) Serapi. Bako conserves a range of vegetation types and supports readily seen proboscis monkeys, flying 'lemur' (actually a colugo, order Dermoptera), bearded pig and pit vipers. Some plants are familiar to Australians, including trees from the families Myrtaceae and Casuarinaceae and austral conifers *Podocarpus*, *Dacrydium* and even *Agathis*. Here can be seen a diversity of insect-plant interactions for which the Old World tropics are famed. An unusual heathland on nutrient-poor, acidic sands derives from ancient siliceous weathered rocks and is known as 'kerangas', meaning 'land that cannot bear rice'. As in parts of tropical Australia with similar impoverished soils, carnivorous plants occur, including the renowned pitcher plants (*Nepenthes* spp.) (Figure 2A), and familiar sundews (*Drosera* spp.) and butterworts (*Utricularia* spp.). Pitcher plants 'feed' by digesting insects, especially ants, lured into and trapped in the pitcher. Morphologies amongst the many species of pitcher species in Bako includes those that contain enough liquid to support a substantial community of insects, including immature mosquitoes, midges and beetles, as well as the inevitable numerous drowned ants. Some of the inhabitants are shown in Figure 1A, a stylised cross-section of a pitcher of a Bornean *Nepenthes*.

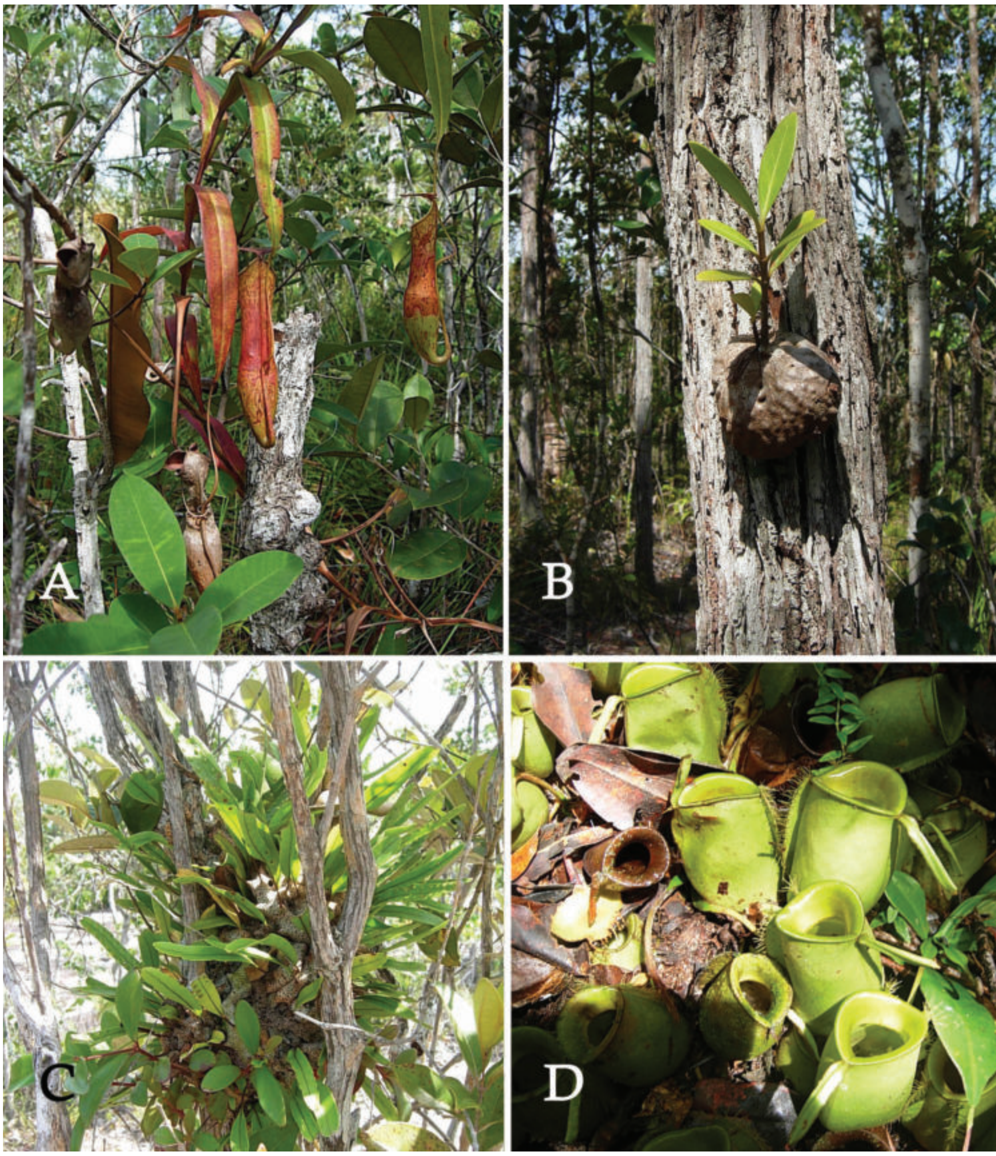

Figure 2. A, *Nepenthes gracilis*, Bako; B, *Hydnophytum formicarum*, Bako; C, tangled colony of several 'ant plants' on *Ploiarium alternifolium*, Bako; D, *Nepenthes ampullaria*, Kubah. Photographs by Penny Gullan.

Perhaps less well known, by other than tropical biologists and horticulturalists, are the so-called 'myrmecophytic' plants that derive much of their nutrients from ants. The relationships are mutualistic with the host plant providing shelter and / or food rewards for their attendant ants and in turn deriving nutrition from their middens ('refuse heaps' / 'debris dumps') of ant excreta. The kerangas vegetation in Bako includes small 'cicada trees' (*Ploiarium alternifolium*, Bonnetiaceae) that are often clad with carton covers created by ants to protect the scale insects that they tend for honeydew. On the bark of these trees are many epiphytic, swollen-tuber myrmecophytes belonging to *Myrmecodia* (*M. tuberosa*) and *Hydnophytum* (*H. formicarum*) (Figure 2B). Both belong to the Rubiaceae, a family that contains disproportionately many 'ant-plants'. Other mymecophytes include two species of *Dischidia* (*D. rafflesiana* and *D. nummularia*), relatives of *Hoya* in the Asclepiadaceae, and even a fern, *Lecanopteris sinuosa*, is entangled (Figure 2C). This unusual fern hosts ants in its dilated rhizome which also acts as the anchor for other epiphytes. Research on the symbiotic ants started with Dan Janzen whose studies in Bako 40 years ago implicated an *Iridomyrmex* species (now *Philidris myrmecodia*) and relatives in these symbioses. Dan's seminal interpretation guided us four visiting Australians (Penny Gullan, Alice Wells, Laurence Mound and your author, Peter Cranston) on our hikes that very much followed in the steps of previous entomologists.

Moving onto Kubah National Park in wetter and taller forest kerangas, we encountered additional plants of interest. The first was not entomological, although the discovery was made during pipetting of the contents of the very common ground-covering *Nepenthes ampullaria* (Figure 2D) seeking aquatic insects, specifically a so-far unreared red chironomid larva. Although the larva was not found, a 2 mm long tadpole pipetted wriggling into the palm of the hand peaked interest. This is the type locality and appropriate pitcher plant host for Asia's smallest frog, *Microhyla nepenthicola*, which grows maximally to one centimetre in length. Described only in 2010, this little frog lives in an abundant pitcher in an easily accessible park just 25 km from downtown Kuching.

Further up the track in palm-rich habitat we encountered a *Macaranga* (Euphorbiaceae) plant by the trailside and with some insider knowledge tapped the large leaves to provoke a defensive response from small *Crematogaster* ants that swarmed over the surface. This reaction confirmed that it was one of the several *Macaranga* species that provide food bodies and extra-floral nectaries, plus sheltered accommodation in the hollow stems (domatia), for symbiotic ants and associated scale insects tended for their honeydew. The 'insight' came from Penny who works with colleagues from the USA (Swee-Peck Quek, University of California, Berkeley), Germany (Brigitte Fialla, University of Würtzburg) and Colombia (Demian Kondo, CORPOICA) on the complexities of this tripartite (scale insect-ant-plant) symbiosis throughout south-east Asia.

Our visit to Sarawak was stimulated by the 5th International Conference on Natural Resources in the Tropics (NRTrop5), splendidly organised by Sin Yeng Wong of the Universiti Malayasia Sarawak (UniMAS) and held at locations 'half way up the Rajang River'. Although entomology was definitely secondary to botany (including ethnobotany) we learnt of the increase in dengue and of the local presence of the 5th malaria-*Plasmodium* (*P. knowlesi*). Laurence and Alice enthused about regional thrips and caddis flies, respectively, many encountered on a large locally organised expedition to the 'Heart of Borneo' earlier in 2017. We heard about the pollination ecology of some of Borneo's strangest plants (including the giant *Rafflesia*), and the diet of edible-nest swiftlets, an important source of local income. Hopefully, we contributed a little to the background of the insects involved and look forward to reading forthcoming publications on the diversity of aroid pollination biologies from the students that presented so ably.

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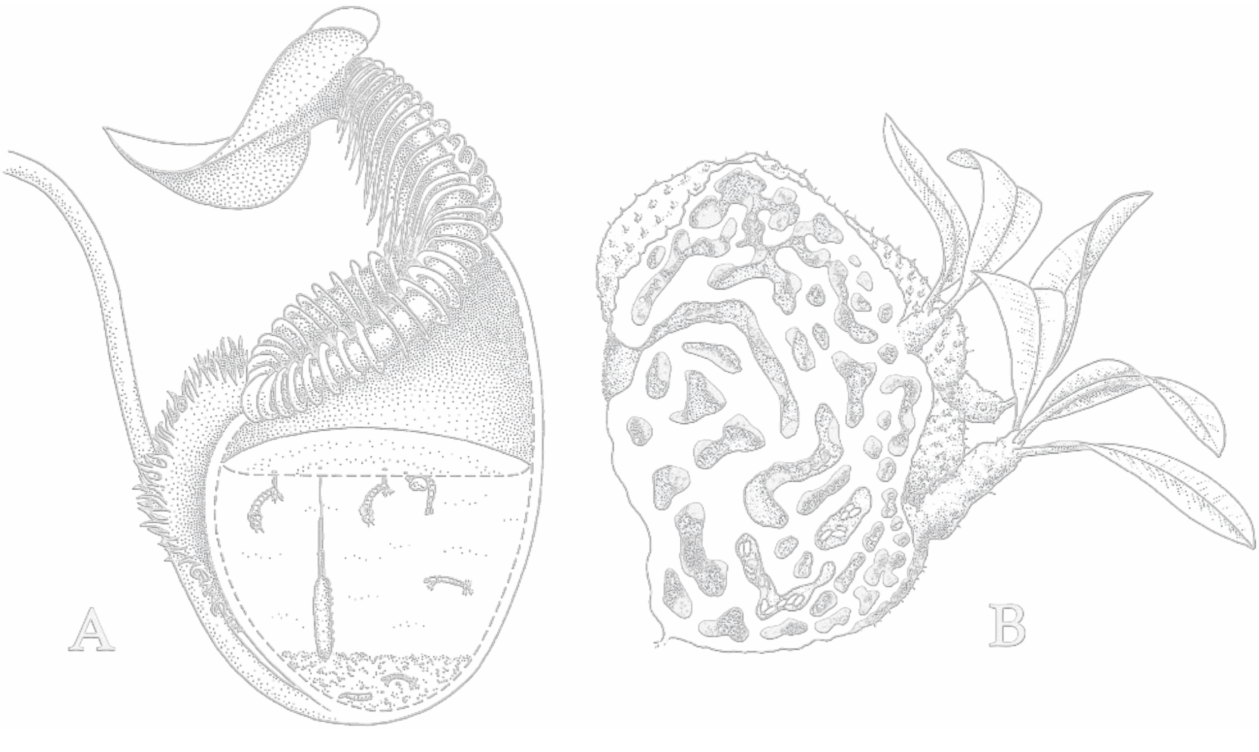


Society News

Honorary Fellow Interviews

Hugh Loxdale

A Brief History

by Peter Smithers

Hugh Loxdale is well-known as an authority on aphid biology but he is equally well known for his broad appreciation of our cultural heritage. RES members will be well aware that his talks and articles are laced with references to music, literature and the arts. As a scientist and poet he has forged a unique career. Like Tolkien's wizard, he has always found himself exactly where he should have been. His career has slipped through a series of academic 'wormholes', to seamlessly slide from post to post. As he commented to me when I interviewed him: "In my whole career I never had a formal job interview", a prospect that seems incredible in 21st century academia.

Hugh's keen interest in the natural world came from his mother who grew up on the edge of Dartmoor and knew the local flora and fauna intimately, a knowledge that she passed on to Hugh, teaching him the names of common plants and insects and introducing him to the concept of evolution at the age of seven. His father sold optical equipment and so was able to supply Hugh with lenses through which he could examine the mini-beasts that he came across, views that sparked a keen interest in insects. His teacher at infant school in Hemel Hempstead, Hertfordshire, where he grew up, was Miss Gwendolyn D. Marshall, later Mayor of the town, who lived out in the country. She would bring into school a selection of insects that had flown into her house during previous evenings and show them to her class. Most of the children were shocked or horrified but Hugh was fascinated, drawing them and attempting to discover what they were. The culmination of these early experiences ensured that Hugh would dedicate his life to exploring and understanding the natural world.

HDL with his home-made Williams-design tungsten filament light trap which he made and used in 1968 to collect moths prior to actually getting a job at Rothamsted in July, 1969. Photo: Front garden of family home, Adeyfield, Hemel Hempstead, probably taken by HDL's mother, Phyllis M. Loxdale.

Just as Hugh was finishing his GCE 'A' levels, his mother was taken seriously ill, so university was put on hold as his father felt he should find a job. Hugh had conducted his Biology 'A' level project on the ecology of bird fleas on Bardsey Island off the Llŷn Peninsula in north Wales, clearing them and then mounting specimens of each species on glass microscope slides and photographing them via a compound microscope. In those days, 'A' level projects were assessed by an established scientist, so Trevor Lewis from Rothamsted came to his school to quiz him. The interview went well and as Hugh was looking for a job in entomology, he sensed an opportunity. Just as Lewis was leaving he asked him if he had any jobs going in the Entomology Department. He was told 'no', but Lewis would bear him in mind. Two weeks later a job offer arrived from Roy Taylor to work in the Insect Survey at Rothamsted.

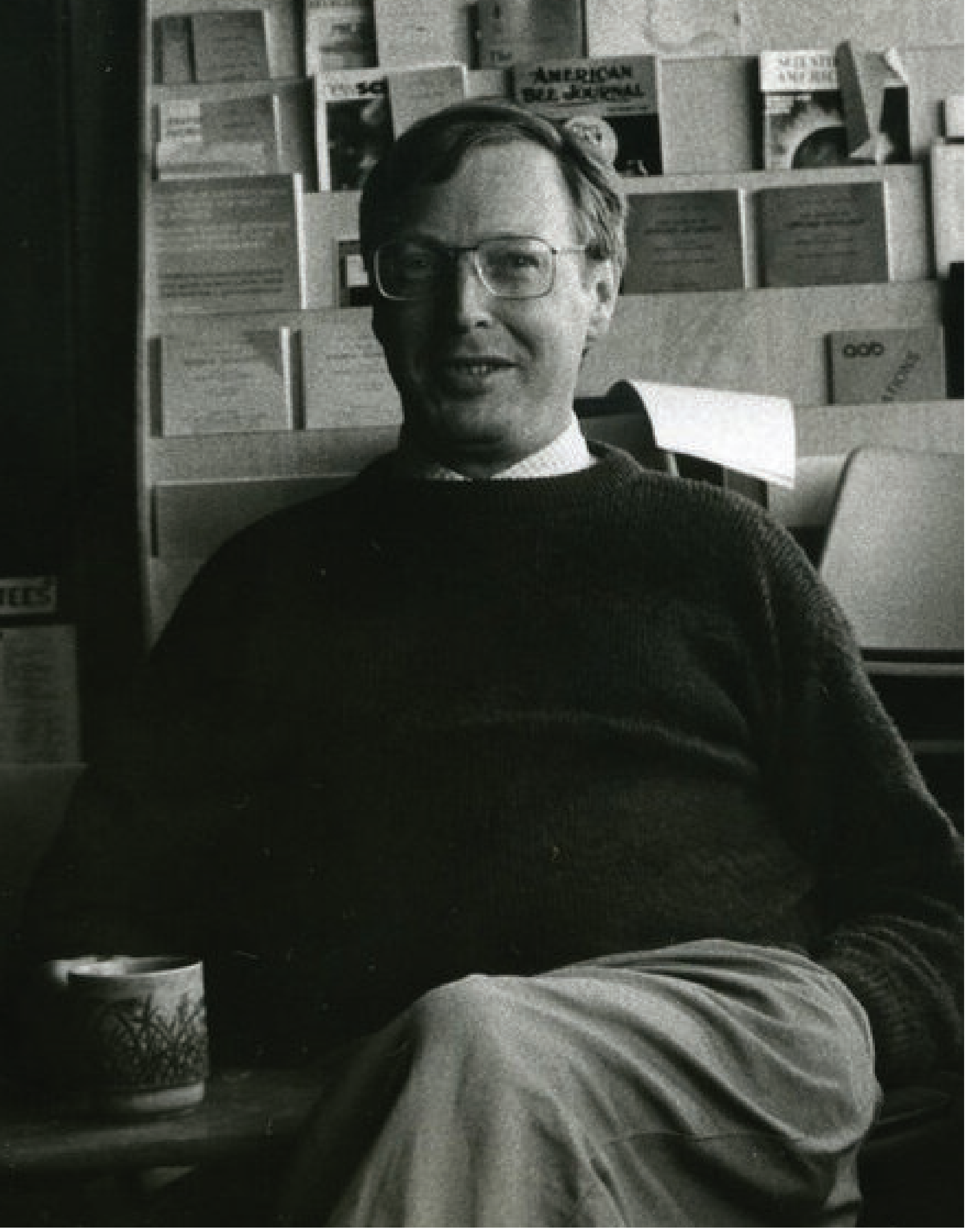
He then spent two and a half years as part of the survey team, identifying aphids from suction traps and moths from light traps. Then quite by chance, whilst he was looking at a notice board in another department, he saw an advertisement for a student bursary from the Agricultural Research Council. He applied and was summoned for interview at ARC headquarters in London, where he was grilled by five scientists, the Chair being none other than Sir Vincent Wigglesworth. Fortunately Hugh had done his homework and he won the bursary, thus enabling him to attend Reading University where Zoology was a major theme in his studies.

When leaving Rothamsted for university they had agreed to offer him a job on graduation. However, after graduating he returned to Rothamsted only to be greeted with surprise: the promised job was not forthcoming. Eventually he was allocated a job in the Bee Department with James ('Jim') Simpson. Now, Simpson had a broad Scottish accent which often made understanding the boss a tricky proposition. Hugh and his colleague Cliff would often turn to each other and ask "What did he mean exactly?", but they would eventually work it out and the research went well.

While the work was interesting, after four months Hugh felt that bee research was not for him, a conviction brought to a head when James Simpson was examining the department's demonstration beehive, which featured a large glass observation window. Jim had decided to remove the window in order to mark the queen and was carefully undoing the retaining wing nuts around the wooden frame. Horrified, Cliff rushed forward shouting "Don't do it Jim, don't do it!" ….but too late. Some three thousand bees fell out of the hive and landed at their boss's feet. At which point Cliff turned to Hugh and said in a somewhat agitated voice "I don't want to be alarmist but…. I suggest we RUN FOR OUR LIVES!" Exiting the building in great haste, they turned to see the boss burst out of the same building pursued by a cloud of angry bees.

Hugh immediately started looking for alternative employment and came across an advertisement for a position at Oxford studying giant water bugs of the family Belostomatidae with John Pringle. He was turned down, as they were looking for someone with tropical experience; however, they liked the look of Hugh's CV and offered him the opportunity to do a DPhil on insect flight muscle, involving studying the ATPase versus mechanical performance of small bundles of glycerol-extracted fibres.

On finishing his tenure at Oxford, he returned to Rothamsted to work with John Turner and set up an aphid group to look into the population genetics of cereal aphids. Then one day John Turner walked into Hugh's lab waving a piece of paper. "Do you know what this is?" he asked. Hugh shook his head.



HDL in the tea room of the Rothamsted Entomology & Nematology Department, 1990. Photo: Dr Tanja Schuler.

"It's my resignation"… and he took out his fountain pen and signed it there and then. John had been offered the post of Professor of Genetics at Leeds University. This left the aphid group with no one at the helm, so Hugh was asked to take on the role.

The group began looking at the genetic variability of aphid populations and found significant differences. Having examined many thousands of aphids under the microscope in the lab, sampled as part of the nationwide Rothamsted Insect Survey of aphid spatial and temporal dynamics using 12.2 metre high suction traps, he became aware that there were real morphological differences between clonal aphids of the same species. Later, using high-resolution molecular (DNA) markers, he and his team found that there were also genetic differences between individuals from the *same* clone, a discovery that led Hugh to question the concept of the clone, which in turn gained him a reputation for 'tilting at windmills', windmills that have subsequently been found to be built on uncertain foundations.

As retirement approached after thirty-six years at Rothamsted, Hugh received an unexpected invitation in late 2006 to go with his wife Nicola to Jena in Germany to continue his molecular ecological studies on aphids. Wolfgang Weisser was then Professor of Ecology at the Friedrich Schiller University's Institute of Ecology and had invited Hugh to take a post as Senior Research Fellow in his department studying the population structure and dynamics of tansy-feeding aphid species. Hugh accepted and worked on the project for two years. Then, when Wolfgang decided to take sabbatical leave, he invited Hugh to hold the fort while he was away and so Hugh took over the post of professor for a further two years, returning to the UK with Nicola in 2013 to finally indulge in retirement.

In 2007 a mysterious letter had been sent from Downing Street to Hugh and Nicola's accommodation in Jena, which it transpired was from the then Prime Minister, Tony Blair. The letter was to inform Hugh that he had been nominated for an MBE, and would he accept? He did and as a result had a day at Buckingham Palace with Nicola, where he was honoured by H.M. The Queen in the Birthday Honours List for 'Services to Entomology'.

Throughout his long career Hugh has been heavily involved with the running of the Society. He has served on Council, as President from 2004-06, and as Honorary Treasurer from 2011-16. He also helped to revamp the Society's journal *The Entomologist*, which had fallen by the wayside back in the 1960s. Hugh's team resurrected it in 1987 and he remained involved for the next two years before handing over the reins to Brian Gardiner. Unfortunately, the journal finally went extinct in 1997. As a result of his continued contribution to the Society he was made an Honorary Fellow in 2016.

Hugh also comes from a long line of poets that go back three generations. He writes about the places he has lived, people he has met, and above all his appreciation of the natural world. Hugh has ten anthologies to his name so far plus the distinction of having some of his poems put to music by the contemporary German rock band "Radio Mellingtone" based in Jena.

Hugh's genial personality, his appreciation of the links between science and culture, a readiness to challenge existing ideas and – as it seems – an ability to be in the right place at the right time, have allowed him to make a unique contribution to entomology across the boundary of two millennia.

The final couplet of his poem "Land of our birth" captures the essence of Hugh's personal philosophy and is one that will resonate across the entomological community as the doctrine of the times in which we live:

Confirming that this place,
For which there is no price,
Indeed, has worth…
And that we should think well of her…
And thus treat her kindly…
Our unique, most lovely Earth.

Diary of the XXVI International Bioacoustics Congress IBAC 2017 – India

Edith Julieta Sarmiento-Ponce MRes.
(js2139@cam.ac.uk)
PhD in Insect Communication

Supervisor: Dr Berthold Hedwig
Reader in Neurobiology, Department of Zoology, University of Cambridge

In October 2017, I presented part of my PhD research in Insect communication at the XXVI International Bioacoustics Congress IBAC 2017, Haridwar, India. I am deeply grateful to the travel grants provided by the Royal Entomological Society, the Guild of Friends – Newnham College, the Cambridge Philosophical Society, the Company of Biologists, and the Department of Zoology at the University of Cambridge that supported my attendance at the Congress. This international conference, outlined below, was an invaluable educational and networking experience, where I learned about cutting-edge studies on acoustic communication on several model species, from insects to mammals. I also had the opportunity to discuss potential post-doctoral positions in the bioacoustics field.

Sunday 8th October 2017

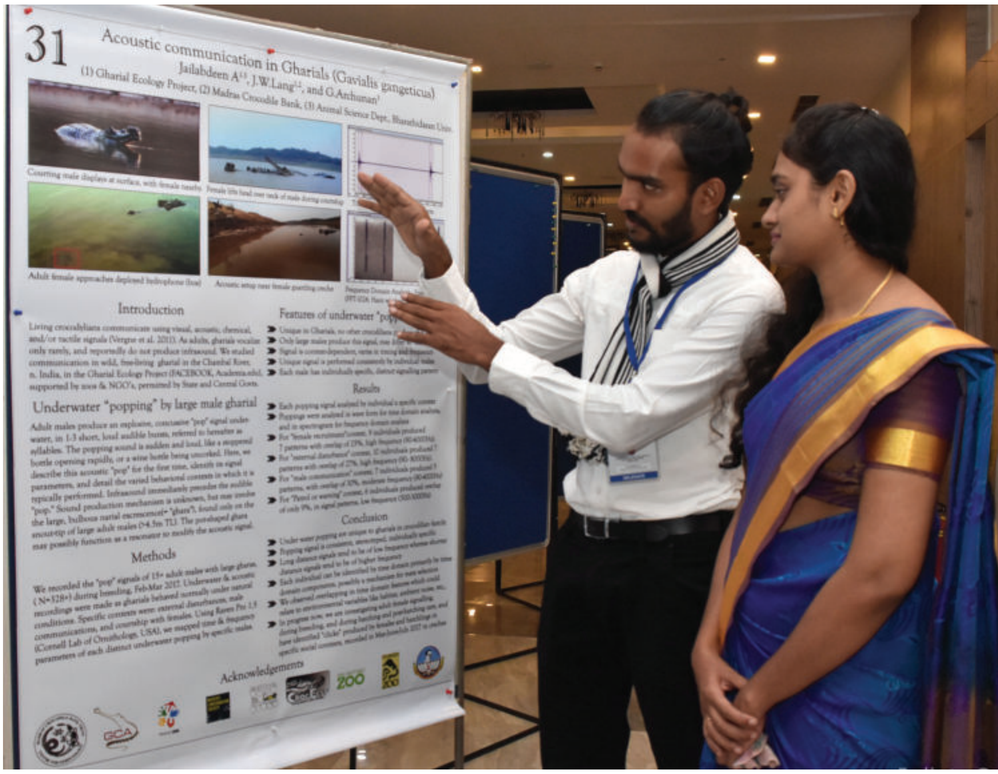
The conference registration started in the morning and was followed by an Indian traditional inauguration ceremony. We were all welcomed by Professor Dinesh Bhatt (the main organiser of the Conference), Professor Ole Larsen, the Minister of Uttarakhand, Shri Prakash Pant, and other distinguished guests who participated in the traditional lamp lighting ceremony. It was explained to me by Pankaj Rajput (a student involved in the organization of the conference) that the lighting of the lamp symbolizes the sharing of knowledge - the flame burning to enlighten all individuals at the conference.

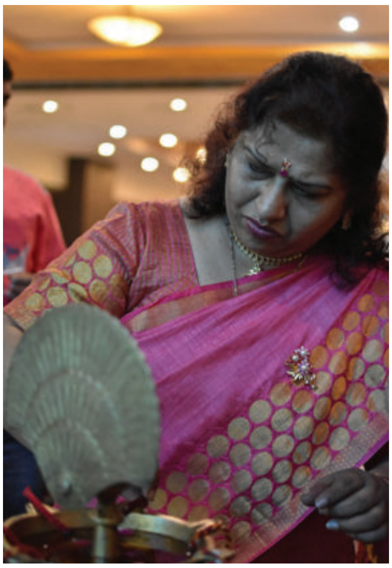
In the afternoon the first Plenary Talk was delivered by Andrea Simmons from the USA on "Tadpole bioacoustics: Sound processing across metamorphosis". This was followed by Symposium I, composed of five international bioacoustics talks on the subject of "Coding strategies in Vertebrate Acoustic Communication"; presentations ranged from Ole Larsen from Denmark talking about the "Strategies for encoding public and private information in propagating sound signals", to Marta B. Manser from Switzerland's work on acoustic communication in meerkats.

During the evening session, I presented one of the projects of my PhD thesis on insect acoustic communication. I talked about "How age of adult female crickets influences the acoustic attraction to male calling song in the cricket, *Gryllus bimaculatus*". The talk was very well received and I was very pleased that some researchers and students approached me afterwards, interested in the research that we are doing at the University of Cambridge. Two students in particular were very keen to know how we breed our crickets in the Department of Zoology! I was very happy to share with them the cricket breeding strategies that we use in our lab.

Monday 9th October 2017

The second plenary talk was given by David Reby from the UK, on "The evolution of size communication in sexually-selected mammal vocalizations". After the tea break, we had the second Symposium, composed of six talks on the subject of "Human voice modulation". After lunch, we attended the third Symposium, comprising another six presentations






XXVI INTERNATIONAL
BIOACOUSTICS CONGRESS
DATE :
8th - 13th
October
2017
IBAC
XXVI INTERNATIONAL BIOACOUSTICS CONGRESS, HARIDWAR, INDIA
2017
ORGANIZED BY :
DEPT. OF ZOOLOGY AND ENVIRONMENTAL SCIENCE
GURUKUL KANGRI VISHWAVIDYALAYA, HARIDWAR, INDIA


IBAC 2017
HARIDWAR, INDIA


Julieta Sarmiento ©


XXVI INTERNATIONAL
BIOACOUSTICS CONGRESS


XXVI INTERNATIONAL
DATE :
8th - 13th
October
2017
Ashtanga Yoga
Both static and dynamic asanas (physical postures) facilitate relaxation, mobilise pranic energy
When practised in conjunction with breath awareness, a state of homeostasis is achieved


Julieta Sarmiento


Nikon

on acoustic communication, sexual selection and reproductive systems. We learned about the relationship between song and colour in the Yellowhammer, acoustic plasticity during competition of bush cricket males, and mate sampling strategies in the context of acoustic communication in crickets.

After the tea break, the first poster session took place. This was followed by the cultural evening, which consisted of a series of fascinating performances by school students from Haridwar, dressed in colourful traditional Indian costumes.

Tuesday 10th October 2017

Julie Elie from the USA gave the third plenary talk of the Congress on “Meanings in Zebra finch vocalizations: an investigation on acoustic and neural codes”. After the tea break, the fourth Symposium on “Prospects for large scale collaborative soundscape datasets: Datamining, Acoustic Recording for Primary Biodiversity Data” took place, composed of three talks, and finishing with an interesting lecture about Indian culture and yoga.

After lunch, we attended the fifth Symposium on vocal neuro-mechanisms, composed of six presentations. The species models ranged from bottlenose dolphins to zebra finches. After the tea break, the second oral session took place during which we listened to eight talks in all. We learned about responses of bottlenose dolphins and harbour porpoises to noise produced by harbour construction, and opioid neuromodulation and singing in male zebra finches. Talks focused on the automatic detection of dolphin whistles, measurements of the cochlear functions of echolocating bats, clustering technology for the analysis and classification of bioacoustic vocalizations, and methods for identifying individual field crickets from their calls. At the end of the day we attended the second poster session.

Wednesday 11th October 2017

The fourth plenary talk on “Song complexity and domestication syndrome in Bengalese finches” was given by Kazou Okanoya from Japan. After the tea break, we had the fourth Symposium on the subject of “Dynamic signalling in a dynamic world”, where we learned about the ontogeny of mating signals and mate preferences in a vibrational insect, vocal plasticity and cultural evolution in the song of the collared fly catcher, and how birds maintain vocal communication in rapidly fluctuating environments.

Before lunch we attended the General Assembly Meeting, where it was discussed, among several issues, where the venue of the next conference, IBAC 2019, was to be held; either in Brighton UK (proposed by David Reby), or Tenerife, Spain (proposed by Fernando Luis Rosa Gonzalez)!

We finished the day with a local excursion, visiting the Haridwar University, called Gurukula Kangri Vishwavidyalaya, which hosted the conference. After visiting the university museum, we headed towards a nature reserve, where we saw monkeys, several bird species, including the famous king fisher, and several arthropods! We had to depart quickly, however, because wild elephants were approaching the road at that particular hour. Finally, we visited the place where a spiritual Hindu ceremony takes place along the Ganges River.

Thursday 12th October 2017

On Thursday morning, after the exciting local excursion, we learnt about "The evolution of variation in structure and function in Mammalian vocalization" in Plenary Talk V, by Marta Manser, based in Switzerland. This was followed by Symposium VII, "Does size matter? Allometric Principles in Animal Acoustic Signals", composed of six talks. We learned about human vocal communication of body size, body size information embedded in penguin vocalizations, the physical bases of signalling body size in harbour seals, and sound structures and calling effort under sexual selection in Ensifera (Insecta, Orthoptera).

After lunch, we listened to eight talks, where we learned about quantitatively comparing female and male song across songbirds, information theory analysis of social calls used by tagged humpback whales in the Los Cabos, México, breeding grounds, and sensing in streams and swarms: echolocation of bats in large groups.

After tea break, there were nine talks, including presentations on an automated clustering of adult mole-rat vocalizations: application of machine learning techniques, determining vocal correlates of emotions in domestic pigs, the use of ecoacoustics to monitoring environmental quality of natural areas, and wing clicking in cicadas (including attempts to clarify the mechanism responsible with high speed video).

During the evening attendees thoroughly enjoyed the conference dinner ahead of the final day of the Congress on Friday.

Friday 13th October 2017

The last plenary talk on "Animal choruses emerge from receiver psychology" was given by Michael Greenfield, based in France. After the tea break we had the final Symposium, entitled "Machine learning methods in bioacoustics", composed of six talks. We learned about estimating animal acoustic diversity in tropical environments using unsupervised multiresolution analysis, automated assessment of bird vocalisation activity, and prospecting individual discrimination of maned wolves' barks using wavelets.

After lunch, we attended the last oral session about the behavioural impact of ship noise on the European hermit crab, vocal repertoire of humpback whales at a near-shore site on the Western coast of India, bioacoustic monitoring as a tool for adaptive management of ecological mine site restoration, and bird song variation across biogeographic and anthro-pogenic barriers in a sky island system. Finally, we attended the closing ceremony.

Overall, this was a diverse and knowledge-packed Congress, from which I learned a great deal and made many new contacts in the field of Bioacoustics. Once more, I would like to express my deep gratitude to the funding bodies which allowed me the outstanding opportunity to present my PhD research at this renowned international conference, IBAC 2017.

Student Essay Competition 2017

This was another excellent year, with forty-seven entries covering a wide range of topics. These diverse perspectives ranged from the lives of social insects to the strangeness of insect biology, tales of parasitic horror to a mosquito's-eye view of the world, and the excitement of being an entomologist to the vast diversity of insect life.

The standards were again very high and the judges had their work cut out selecting the winners. However, after much discussion and debate the list of finalists was finally whittled down to the top three plus two runners up.

The judges would like to congratulate everyone who entered the competition and thank them for the time and energy that they have put into their contributions. It is always a great pleasure to read these contemporary visions of insect science, which are penned by aspiring entomologists. It is also reassuring to know that so many young people are passionate about insects and the role that they play in our world. The judges eagerly await your entries for 2018.

Peter Smithers
Royal Entomological Society
SW Region Hon Sec
Book review editor for *Antenna*
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1st Prize

Toxic teamwork and the Müllerian mimicry mystery

James Fage
Masters student at Harper Adams University

A bird scans a forest clearing for prey, its sharp beady eyes searching for the smallest sign of movement. A bright orange butterfly flutters into view, a contrast from the dull browns of the insects that try to remain unseen. Seeing an easy meal, the bird swoops in, giving chase. Eventually triumphant, it brings the limp body of its prey to a nearby branch to take its first bite, only to be overwhelmed by an acrid, bitter taste – poison. The predator stops eating and reflects on its mistake. It attacked several butterflies with that wing pattern recently, and each one was inedible and not worth the energy spent catching. Perhaps, the predator decides, it will start avoiding this prey in future.

Poisons and other noxious or foul tasting chemical defences are no rarity in nature, but this is not a story about those. There is a twist to this tale – without knowing it, the predator had been feeding on two completely different poisonous species all along.

The imitation game

"Natural Selection explains almost everything in Nature, but there is one class of phenomena I cannot bring under it,—the repetition of the forms and colours of animals in distinct groups, but the two always occurring in the same country and generally on the very same spot" – letter by Alfred Russel Wallace to Charles Darwin, 1860.

Being an insect is tough. Competition for scarce food, plants that resist being eaten, and of course, predators. The threat posed by predators is evident in the vast range of different approaches to antipredator adaptations found in insects. Hiding, camouflage, flight, fighting back, mass simultaneous hatching, or distasteful/toxic chemicals to discourage attack, to name a few. Naturally, some species try to get a free ride on poisonous species by imitating them, without producing any defences of their own. Predators mistake them for something they'd rather not attack, and give them a wide berth. This scenario of the harmless imitating the poisonous, so-called "Batesian mimicry" (after its discoverer, Henry Walter Bates) is intuitive, and easy to understand. Why though, would a poisonous species want to copy another?

This was the question that came into the mind of the German naturalist Fritz Müller as he observed *Heliconius*, *Ituna*, and *Thyridia* butterflies flying together in Brazil. All shared the same wing pattern and were known to be toxic – indeed, Müller noted that these species were flying out in the open and were undisturbed by predators. To find the answer to this puzzle, we need to see the world through a predator's eyes.

Entering the mind of a predator

No predator is born knowing which prey make the best meals, and which to avoid. Instead, they learn from experience as they go along. As a result, a predator needs to eat several poisonous individuals before it is sufficiently "educated" to avoid that prey. Well-defended prey use bright and distinctive colours to aid predator learning, aiding their distinction from other prey.

Because of predator learning, poisons and bright warning colours are not a free pass to total immunity from predators. To reap the benefits of their defences, the prey first have to educate the predator, which still costs lives. These species lose much fewer individuals to predators than other, edible species, but these losses are still an issue. Naturally, species have tried to reduce this burden further.

A problem shared is a problem halved

Another way of looking at the above problem would be to see that the cost of predator education is always more or less fixed. It doesn't matter how big or small the prey population is – each predator has to "sample" a fixed number of prey (every so often) to learn to avoid it. The larger the prey population becomes, the smaller this fixed cost becomes as a fraction of the total population. Thus, the per-individual chance of being eaten by an uneducated predator goes down the more fellow prey there are. It's safety in numbers! What better way to bolster your effective population size than by joining forces with another species? By converging on the same wing pattern or other warning signal, two species can become indistinguishable to predators (although not to a wily entomologist) and both contribute to predator education together.

Müller's Hypothesis

Müller's explanation was visionary and ground-breaking for its time, and is still well supported today. Not only did it provide further support for Darwin's theory of evolution by natural selection, but it was the very first mathematical model of frequency based selection in history. Unlike Müller himself however, you needn't travel to the Amazon to spot Müllerian mimicry in action – look no further than the shared yellow and black warning signals of the bees and wasps in your own back garden!

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2nd Prize

A sad day at the office

Maggie Gill

Harper Adams University

The sun sets on a warm June evening as I make my way across the fields. I crest the brow of the hill and my destination comes into view, tucked into the corner of the field stand five bee hives on concrete blocks. I pause to plan my next move; the hives are old and have holes around the bottom where the wood has rotted away, so how best to seal them up? I've come prepared with duct tape, foam and petrol. Its nearly dark now and the earlier rain has stopped the honeybees from flying, but I know I'll have to be quick because as soon as I start disturbing the hive the bees will come out to see what's happening, and they won't be happy! I gingerly stuff the larger holes and the entrance with the foam and quickly duct tape up the smaller holes as a few bees start to emerge from them, then I double check the hive for holes, taping as I go, as it's of the utmost importance that the hive is totally sealed. It's properly dark now, and I've had a long day so I steal myself for the worst part of the job. I pour out a pint of petrol in a plastic jug, remove the roof of the hive and quickly pour in the petrol and replace the roof. The honeybees roar as the fumes from the petrol kill them, then after a few seconds everything is quiet again.

So why am I killing colonies of honeybees under the cover of darkness? I'm not some escaped psychopath with a honeybee vendetta, instead I work for the National Bee Unit as a Seasonal Bee Inspector. It's my job to inspect colonies of honeybees for statutory notifiable diseases and pests and treat any diseased or infested colonies to prevent the further spread of infection. Unfortunately, this colony has American foulbrood. I started the day by inspecting all of the beekeeper's colonies, carefully taking the roof and supers off and stacking them so as not to squash any bees, then taking each frame of brood from the brood chamber, I checked for the queen and then shook all of the bees from the frames back into the brood box so I could check the larvae and sealed brood for signs of disease. All of the larvae were healthy and pearly white, neatly curled in the bottom of their cells; however, in one of the beekeeper's hives I notice that some of the wax capping's of the pupating larvae are dark, greasy and sunken with small perforations. This isn't a good sign – the capping's should be dry, domed and a nice digestive biscuit colour; when I insert a cocktail stick into the cell and pull it out a toffee coloured mucus rope emanates, my suspicion of American foulbrood is confirmed with a lateral flow device, the diagnostic test kit bee inspectors use to confirm disease.

There's no treatment for American foulbrood and as infected colonies are doomed to die from the spore forming *Paenibacillus larvae* bacteria, they are destroyed and infected equipment is sterilised to prevent the spread of the disease to other colonies. If left untreated the bacteria would spread to the rest of the brood, the colony would dwindle and die, and honeybees from other colonies would rob the hive of honey stores, spreading spores of the bacteria to their own colonies, insuring their own deaths. Tomorrow morning, I will return to the infected apiary and dig a meter square pit to burn the dead bees and frames, then I will scrape all the wax and propolis from the hive equipment before sterilising it with a blowtorch so it can be reused. The beekeeper is understandably upset by today events, and worries that it's his fault that his bees are sick, but I reassure him that anyone's bees can become infected, the pests and diseases that we look for take no notice of beekeeping experience or the quality of equipment used when they infect a colony. Hopefully, when I return in six weeks to recheck the colonies for signs of disease, I'll be able to give the beekeeper the all clear and remove the standstill that prevents him from moving any bees or equipment until these are disease free. I'll spend the next few weeks checking all the honeybee colonies within five kilometres for disease, in an attempt to track down the source of the infection and stop it from spreading further. Fortunately, today isn't a typical day for me; the vast majority of colonies that I look at are disease free, and I get to spend my time helping and offering advice to beekeepers. It's not very often that I have a bad day at the office.

3rd Prize

1 Star Bee & Bee Review

Rhiannon Dowling

3rd Year Biology Student on Placement at NBGW, Imperial College London

Bees! They're mostly small, fluffy, round, a bit stingy, but most of all, incredibly important for the pollination of our plants. It has been all over the news – our bees are declining [1, 2]! Their habitat is being destroyed! We must help them!

Commendably, the public has noticed and they really want to help.

Awareness of the plight of the bees has increased tremendously over the last few years. Now, it is easy to buy bee hotels and plants which are 'good for pollinators'. But, despite this interest, our native bees are still struggling and in decline. Are public efforts helping or are they hindering?

Unfortunately, recent research suggests our efforts are likely to be hindering [3]. Unmanaged bee hotels are causing our cavity nesting bees and wasps to be at greater risk of disease and parasitism. There is also the issue that less than 5% of our bee species in the UK will even use bee hotels. The majority of British bees are ground nesting – a clear patch of bare earth may provide a more suitable habitat for a wider range of species, while also being cheaper and easier to maintain. Still, the love of bee hotels prevails, so better recommendations on care should be more widely available.

Without proper care, bee hotels become a festering mess. Debris builds up, pollen mites in their droves will munch away at the stores left by the mother bees for their young larvae and water begins to seep in. Cut bamboo stems, pinecones and straw all provide perfect hiding places for mites and parasites. The thin, split, hollow stems, like tubes of Smarties, are full of goodies for the parasitic larvae of wasps and flies. The thinly walled tube is no match for the formidable looking ovipositor that many female parasitic wasps wield and the cracks allow those with shorter ovipositors to squeeze through into the bee's cells.

Tubes that are not cleaned out regularly also have the threat of kleptoparasitic mites. *Chaetodactylus osmiae* lives in the nests of the Red Mason Bee (*Osmia bicornis*) [4]. Although *C. osmiae* doesn't directly predate on the bee larvae, it does eat the pollen stores and, when the young bee emerges, it hitches a lift. Hitching a lift isn't so bad – no worse than letting a hitch hiker in the pouring rain sit in the back seat of your car until the next junction. The problem occurs when 100 hitchhikers try to sit in the back of your car.

Now, the car cannot move. You are stuck and unable to drive with 100 hitchhikers desperately clinging on to the back of your car. This is essentially what happens to the poor, young Red Mason Bees which are taking their first flight as they emerge from their unclean cells. In a fresh tube which has been cleaned, there will only be a few such hitchhiking mites brought in by the mother bee, but in an old tube there may very well be hundreds waiting for a lift from the last brood that was inside it. This is because when they have killed the bee larvae by eating all of the stores the year before; they lie in wait for the next brood as inert deutonymphs.

So what can we do to encourage these cute bees into our gardens without killing them? A fresh hotel made from pine with holes drilled 10-15cm deep, separated by 2cm to prevent disease transmission and hole diameters a range of sizes between 2mm and 15mm is ideal. A cover to prevent rain and a platform at the bottom is preferable for newly emerged bees to warm up and begin their adult lives. Markings should be burnt or painted on the front as well, as the females can get very confused and go into other nests by accident if the front looks the same. Too many markings can also confuse the females however, so think less like Jackson Pollock! Surprisingly, they also love a light blue roof so that they can easily relocate their nest again amid the darker colours. Placement of the hotels is also important – above 2ft to prevent ants, in a protected spot away from wind, south facing and, most importantly, kept dry to prevent rot [5, 6]. This hotel should then be replaced annually or biannually to prevent mite build up.

Hopefully with these tips, those 1 star B&B's will end up being luxury 5 star hotels – just what our little helpers deserve!

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Runner up

Get off my Brassicas! (One gardener's battle for Broccoli)

Susan Hammond

Msc Entomology,
Harper Adams University

I love Purple Sprouting Broccoli: I love the colour of the flower, the crunchiness of the stalk, the way the water turns purple as it cooks and feeling healthy simply by having it on the plate. More than eating it though, I love *growing* it, or more accurately, *trying* to grow it.

Every year I watch the shoots appear in the pots, protect them from frost, keep them watered and thin them out so the strongest have the best access to nutrients and sunlight. The highlight is planting out the young plants and seeing them flourish in the ground. It is around this time that the Large White (*Pieris brassicae*) appears. Initially I celebrate that my small urban garden can attract any wildlife at all. That changes though when I notice a proliferation of small holes in the leaves of my beloved Broccoli.

The butterflies have laid their eggs in clusters on the underside of the leaves. The caterpillars hatch and start munching their way through their favourite food (we do at least have that in common!). I have been seen picking caterpillars off leaves and yelling 'Get off my Brassicas' as they are unceremoniously flung to a less Broccoli-centric part of the garden. This year however, I discovered an unlikely ally.

I noticed a Large White caterpillar being very still at the top of a fence post. It seemed so out of place that, rather than flinging it down the garden with its contemporaries, I left it where it was to see what happened. The following day it was still there, but was now surrounded by what looked like lots of tiny balls of yellow felt. What's more, the caterpillar was tending to them! The tiny balls of felt were in fact the cocoons of a wasp. Not the yellow and black stripy sort that ruins picnics, but something very small (adults are just a few millimetres long) and on the face of it quite unremarkable: Its name is *Cotesia glomerata*.

Cotesia glomerata is a parasitoid wasp. The female has a sharp 'ovipositor' which pierces the outer surface of newly hatched caterpillars. She places 25-30 eggs within each caterpillar where they are protected from harm[1]. Despite the caterpillar's extra cargo, it continues to grow until it is ready to pupate[2]. It is at this point that the wasp eggs hatch and the larvae all break through the skin of the caterpillar and spin a cluster of cocoons[3]. Incredibly, this doesn't kill the caterpillar which survives for another couple of days guarding the cocoons! Unsurprisingly, being parasitised takes its toll and, as the adult wasps emerge from their cocoons, the caterpillar dies.

I'm amazed at how tiny wasps locate tiny caterpillars. There have been lots of studies on what visual and chemical signals might be helping them locate hosts. One of the most surprising findings is that the wasps don't actually search for the caterpillars. Instead, the damaged plants give off the signals they're attracted to[4]. It's as if the cabbage is calling for help! Perhaps the weapon I need to attract the wasps to my Brassicas is a sacrificial leaf and my trusty hole-punch!

As a keen gardener the thought of anything helping with the battle against the caterpillars fills me with joy. If you're not a gardener or entomologist though it is understandable that you could find the fate of the caterpillar a little distasteful. If that is the case, take heart from the fact that there is a sting in this tale. There is another wasp (a type of Ichneumonid wasp) which is also a parasitoid, and its host of choice just happens to be our friend *Cotesia glomerata*: Our parasitoid becomes the parasitised.

Harvest this year was not a success – not one leaf or flower of Purple Sprouting Broccoli made it to my table. Next year, I shall follow Gardener's World's advice and cover the plants with netting to prevent the adult Large Whites laying their eggs in the first place. In the meantime, I shall take heart that at least one species of butterfly and two species of wasp fed well on my Brassicas this summer. My small urban garden sustains more wildlife than I realised…

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Runner up

Britain's only scorpion species could be making plans to increase its range across the UK!

Sam Finnie

Harper Adams University
MSc Entomology

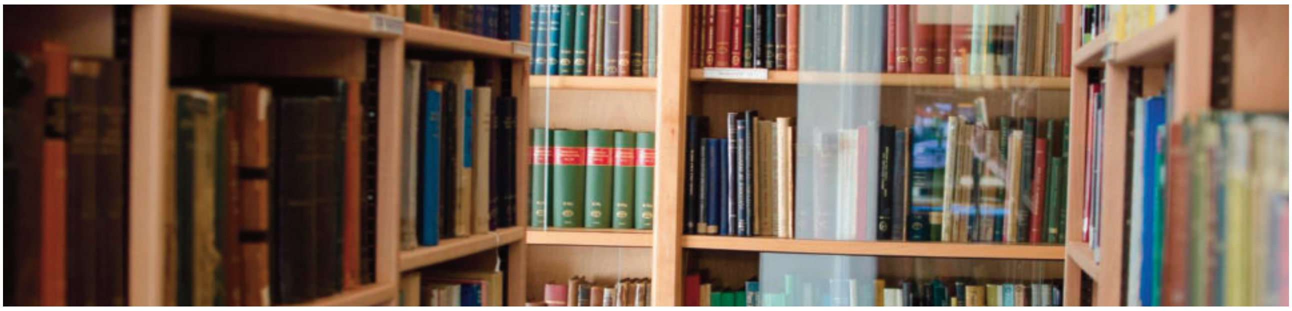
The invasive European yellow-tailed scorpion is, to date, the only established species of scorpion in the UK. It is thought to have arrived here by sneaking onto shipments of Italian masonry in the 1800s. A population estimated at being as much as 15,000 strong is currently thriving in Sheerness Dockyard on the Isle of Sheppy, Kent. These arachnids can grow up to 45mm long and are predominantly black, with yellow-brown legs and tail (hence the name!). They are seldom seen as they hide themselves away for most of their lives becoming active only to feed and breed, which is usually only on warm, dry evenings, although they have been sighted as early in the year as February. They feed on any creature small enough and unfortunate enough to come in range of their strong pincers and if food is scare they can even feed on each other! The preferred food of the yellow-tailed scorpion are woodlice, a prey item of which there is an abundance in Sheerness Docks.

If you want to see one for yourself, these scorpions can easily be seen at night (albeit, with some specialist equipment!) as all scorpion species glow a fluorescent turquoise under a UV lamp, meaning they can be spotted in even the deepest of crevices. It is not understood exactly how scorpions benefit from glowing under UV light, but it is known that the fluorescence is caused by the accumulation of a chemical called beta-carboline in the exoskeleton, which glows under UV light. One theory is that this fluorescence could aid in help shielding scorpions from damaging UV rays which are emitted by the sun by converting UV light into harmless visible light. Another possible theory is that this emitted glow from UV light could attract moths and other insects that scorpions prey upon. Whatever the reason, seeing a scorpion glowing under UV light is a truly beautiful spectacle.

Man-made bridges currently connect the Isle of Sheppy to the mainland, and this species of scorpion clearly has no problems with hitching a ride, as sightings have been recorded in Harwick docks, Pinner, Tilbury docks, Portsmouth docks, Southampton docks as well as Ongar underground station; however, none of these areas have populations as long established, or as successful, as Sheerness Docks. It is thought that the reason this scorpion has been confined to Sheerness is the relatively high temperatures and low annual rainfall. This, combined with the sheltered environment in Sheerness and the lack of biological competition in England, make a perfect scorpion-friendly habitat.

It is also the northernmost population of scorpions in the world, making it the hardiest species of all scorpions. These miniature assassins can survive on as little as four meals a year and can even supercool, which means they can survive subzero temperatures, so they have no trouble hunkering down throughout the cold British winter. An increased temperature has been shown to significantly increase the activity of both male and female yellow-tailed scorpions. The mean annual temperature of the UK has risen by 0.25% over the last 30 years and is continuing to rise, therefore higher temperatures can be expected to increase the availability of suitable habitat for England's yellow-tailed scorpions. Considering their adaptability, is it possible that the range of these animals will start expanding, so the number of sightings is expected to increase in the coming years, especially in areas where rainfall is relatively low.

Not to worry, though! These little scorpions may look scary, but they very rarely use their stinger and when they do, it is said to be likened to that of a bee sting. In truth, native populations of scorpions play a very important role in their ecosystems as they are polyphagous predators and they help in controlling the populations of their prey. To date, there are no studies which document any negative impacts of scorpion species on an ecosystem, but this is something to look out for in the future.



Library News

March 2018

Val McAtear (Librarian)

In the past, new books added to the Library have been listed in *Antenna*. However, as we now have only one selection meeting a year this list is getting too long to continue with this approach, especially as there is so much other interesting material to fit into *Antenna*. New acquisitions will nevertheless continue to be listed on the library pages of the Society's website and if anyone would prefer me to send a copy of the list by e-mail or in the post just contact me by phone or by e-mail.

Following the tradition of the nineteenth century "Transactions of the Entomological Society of London", donations to the library will continue to be listed. I am sure you can appreciate how valuable donations, either by the authors or their publishers, are to the library and I think Fellows and Members should be aware of such generosity. Sometimes books come to me via the *Antenna* reviewers and I am grateful to them too. For me it is especially good to receive books that, because of the requests made on the Library's resources, I know to be in the pipeline.

Whilst talking about new acquisitions, please remember that the Library Committee appreciates Fellows' and Members' suggestions for new titles for the Library. There are so many new Entomological books that it is important that we choose books that will be used. Recently, following a request, we purchased a copy of the "Trichoptera Larvae of Finland". It proved to be a high-quality publication.

Finally, I know that it is not always easy to visit the library but I am always happy to put many of our books in the post. This does not, unfortunately, apply to journals, but I will make PDF's or photocopies on receipt of a copyright request form. We still charge only 10p per page plus VAT to Fellows and Members. For those wanting to use this service, please remember that a copyright declaration is legally required for all copies made of papers still in copyright. For those that would like to search the online database of the catalogue, a PIN number is all that is required, with one available on request. Please contact me if you require more information about the library: lib@royensoc.co.uk

Recent Donations to the Library

Ian D. Loe "A Passion for Butterflies: The Life & Travels of a Butterfly Artist" donated by Ian Loe

Eddie John & David Sparrow "An Introduction to the Wildlife of Cyprus" donated by Eddie John

J. Thomas, T. Eccles & S. Bowestead "The Coleoptera of the Sandhills of South Lancashire" donated by RAVEN Entomological & Natural History Society

P. Duris & E. Diaz "La Fabrique de l'Entomologie Leon Dufour (1780 - 1865)" donated by Presse Universitaires de Bordeaux

Jeffrey Glassberg "A Swift Guide to the Butterflies of North America" donated by Peter Smithers

Ian D. Hodkinson "The Ague: A History of Indigenous Malaria in Cumbria and the North" donated by Ian Hodkinson.

J. A. Stockan & E.J.H. Robinson "Wood Ant Ecology and Conservation" donated by Jenni Stockan

Andrew Wood "Butterflies of Hertfordshire & Middlesex" donated by Hertfordshire Natural History Society

M.J. Samways "Dragonflies & Damselflies of South Africa" donated by Michael Samways

J. Feltwell "Black & White in the Wild" donated by John Feltwell.

Helmut F. van Emden & Richard Harrington "Aphids as Crop Pests" donated by Richard Harrington.

Various books bequeathed by Martin Cooper from his library.

SCHEDULE OF NEW FELLOWS AND MEMBERS

as at 7th March 2018

New Honorary Fellows
None

New Fellows (1st Announcement)
Professor Guy Smagghe
Professor David Maxwell Suckling
Dr Zhi-Shun Song
Dr Sunday Ekesi
Dr P G Padmaja

Upgrade to Fellowship (1st Announcement)
None

New Fellows (2nd Announcement and Election)
Dr Shashikant Shiddappa Udikeri (as at 6.12.17)
Dr Krishna Kumar

Upgrade to Fellowship (2nd Announcement and Election)
None

New Members Admitted
Mr Paul Latham (as at 6.12.17)
Dr Tim Willey (as at 6.12.17)
Mr Jibin Johny (as at 6.12.17)
Mr David Jeffrey Perry
Miss Amanda-Jayne Tomkins
Miss Anaelle Stenman
Mr Mohd Amierul Fikri Mahmud
Miss Sophie Thorogood
Miss Elysha Paterson
Mr Sampath Weerakoon

New Student Members Admitted
Mr Sean Tomlinson (as at 6.12.17)
Ms Michelle Louise Davis (as at 6.12.17)
Ms Rebecca Marie Whitla (as at 6.12.17)
Mr Timothy David Penny
Miss Fiona Teltscher
Miss Poppy Stevens
Miss Kirsty Godsman
Mr Jiang Bin

Re-Instatements to Fellowship
Dr Filipe Dantas-Torres

Re-Instatements to Membership
None

Re-Instatements to Student Membership
None

Deaths
Mr H J Berman, UK, 1960
Dr P J Edwards, UK, 1987
Mr M Cooper, UK, 1983
Dr C W N Holmes, UK, 1986
Mr M J Thomas, UK, 1976
Mr D M Robertson, UK, 1984
Mr B H Harley, UK, 1981
Dr B R Champ, Au, 1956

OBITUARY

Bruce Richard Champ

1930 – 2017

Bruce Champ, a Fellow of the Royal Entomological Society since 1956, and a world research leader on postharvest pests of food commodities, died at the age of 87 on 19th October 2017 at his rural property just north of Canberra, Australia.

Born in Queensland, Bruce graduated from Queensland University and began work in the Entomology Branch of the then Queensland Department of Agriculture and Stock (QDAS – later Queensland Department of Primary Industry QDPI) in the early-1950s, where his interest in research on postharvest pest problems was fostered. In the mid 1950s, he gained a Nuffield Fellowship for PhD studies at Imperial College, UK, and after being awarded his PhD and DIC (Diploma of Imperial College), returned to his position in QDAS where he worked for many more years. His research included studies on the rapidly emerging problem of insecticide resistance in grain pests that led to several publications in the *Journal of Stored Products Research* including its first issue (Peter Credland *pers.comm.*).

In 1969, the Division of Entomology of the Commonwealth Scientific & Industrial Research Organisation (CSIRO) in Canberra established, with significant industry support, the Stored Grain Research Laboratory (SGRL), with a mandate to work on the major postharvest problems that posed severe challenges to Australia's grain industry – a major contributor to the nation's export earnings. After the first few years of its operations, Bruce moved south to Canberra to join SGRL and later became its head.

Under Bruce's leadership, SGRL made many major contributions to the Australian grain industry, including the development of new fumigation strategies, sealed storage, bunkers, new protectants, improved grain cooling, and pest monitoring systems. These developments were all based on leading-edge research on the biology and ecology of stored grain insect pests, modelling and controlling the temperature, moisture and aeration of stored grain, and chemical and other controls for grain pests. Bruce placed special emphasis on integration of these pest management approaches into systems that drew together research outputs from different areas, and that, of overarching importance, led to major practical outcomes of benefit to all stakeholders. It is no coincidence that independent economic impact assessments of SGRL's research estimated that for every dollar invested there was a nine-fold return in dollar terms to the Australian grain industry.

With the focus on Australia's grain exports, it was inevitable that Bruce also ensured that SGRL operated in an international as well as national context, encouraging strong collaboration with many overseas institutions – including regular exchanges with postharvest research scientists from the developing as well as the developed world. Among many major international initiatives that Bruce conducted was the first global survey, by FAO, of pesticide resistance in storage pests, during which, together with C.E. Dyte (also a RES Fellow), he visited over 80 countries. The visit to China was the first by a FAO technical representative after China joined FAO in 1973 (Ed Highley *pers.comm.*). The report on this work has become one of the most highly cited publications in the postharvest sector. Bruce also played a central role in establishing the global networking platform GASGA (the Group for Assistance on Systems relating to Grain After-harvest – now called the Global Postharvest Initiative (GPhI)) with membership that includes FAO and UNIDO, as well as government agencies from the UK, other European nations, the USA, Canada, Japan and Australia.

In 1982, the Australian Government, having recognised that there was an urgent requirement for its international development programmes to include science and technology in addition to the existing focus on economics and policy, established an independent government organisation, the Australian Centre for International Agricultural Research (ACIAR). Bruce was seconded from CSIRO in 1983 to develop a postharvest research and development programme that focused initially on grains. From the outset, he made certain, through fully participatory processes, that the programme was driven by the priority needs of stakeholders in the developing world and not by researchers' own agendas. That said, Bruce ensured that the ACIAR partnership model also addressed Australia's postharvest challenges and built the capacity of young researchers in the developing world as well as in Australia.

Bruce later greatly broadened the scope of the postharvest programme beyond grains to include perishables – fruit and vegetables, as well as dried fish, which are important food commodities in many developing countries. He accorded very high priority to food safety, and the programme addressed the major problems of mycotoxins in food and feed. ACIAR's *Mycotoxin Newsletter* was circulated world-wide for over 13 years.

Bruce believed passionately in the need to communicate the outputs of research and the translation of these into practical outcomes for the broadest possible audiences, from researchers and policymakers to producers and processors in food commodity value chains. The *ACIAR Postharvest Newsletter* was, from 1984 to 2003, a major conduit spreading such information. Bruce was equally passionate about the need for scientific excellence in his discipline of entomology, and at just 31 years of age became President of the Entomological Society of Queensland and founding Editor of that Society's journal (Geoff Monteith *pers.comm.*).

Bruce also played a central role at a national level through the establishment of the Australian Entomological Society in 1965, and was the founding editor of its journal (now a Wiley publication *Austral Entomology*, and the leading international journal for southern hemisphere nations). Bruce was for 27 years the Regional Editor of the *Journal of Stored Products Research*, and the tribute by the then Editor-in-Chief in that journal (Peter Credland *pers.comm.*) is yet further testimony to Bruce's passionate belief in the need to disseminate quality research outputs and thereby achieve uptake of solutions to major challenges in the postharvest sector. Bruce was instrumental in organising the 6th International Working Conference on Stored-product Protection, held in Canberra in 1994. It attracted more than 400 participants from over 30 countries.

His output as editor of major scientific proceedings and other significant publications during his years at CSIRO and later ACIAR was prodigious – as can be seen, for example, from the ACIAR publication list – much of this work undertaken during 30 years of collaboration with Ed Highley, a technical editing and production specialist.

In the 2003 National Honours list, Bruce was admitted to Membership of the Order of Australia 'For service to agricultural research and entomology, particularly through the development of stored grain insect control'.

Bruce was married twice, sadly losing his first wife Anne, mother of their two sons, to illness in 1982. Later in his working career and after retirement, he enjoyed life on the small farm that was home for him and his second wife Maree, as well as a gathering place for their children and stepchildren, grandchildren and other family, and many friends.

Acknowledgments. I had the privilege of being a friend and colleague of Bruce for many years at CSIRO and ACIAR, but could not have compiled this obituary without the information provided by Ed Highley and Greg Johnson personally and in their tribute in ACIAR's *Partners* publication, and by Geoff Monteith (Queensland Museum) personally and in the *News Bulletin of the Entomological Society of Queensland*. Peter Credland (former Editor-in-Chief of the *Journal of Stored Products* Research) and Chris Haines (Natural Resources Institute, NRI, UK and former President of the Royal Entomological Society) also provided valuable information on Bruce's many international contributions.

George Rothschild. Emeritus Professor, Natural Resources Institute (NRI), University of Greenwich, UK

OBITUARY

Roger Crosskey

1930 – 2017
an appreciation

Roger Crosskey was a man of his time – he not only witnessed the development of a new field from the outset, but contributed significantly to its establishment and progress. From solid field-experience in tropical, colonial Africa on matters of great practical significance, through extensive taxonomic research underpinning biological studies to a sense of public service via high-impact synthetic works, he made major contributions to science and society. If that was not enough, he was regarded with great affection by his colleagues and the many scientists around the world that he helped so generously.

Richard P Lane
Kilmington, Devon, UK
Formerly, Director of Science, Natural History Museum, London

Peter S Cranston
Honorary Professor, Australian National University, Canberra

John B Davies
Hoylake, Wirral, UK
Medical Research Council (retired)

Roger Ward Crosskey was born on 29th January 1930 in Croydon in Surrey, England, a town on the outskirts of London. He had an interest in natural history and especially entomology from childhood and had a collection of butterflies, but they "bit the dust due to cats and small brothers" so he resorted to water beetles. He was educated at Whitgift School, a private school, in Croydon where he was encouraged in his entomology by a very helpful biology teacher before winning a place to Imperial College of Science and Technology, then part of the University of London. Imperial College (IC) was a mecca for entomologists as it had an impressive record of entomological research and of preparing scientists for work in the tropics, especially the British colonies. This 'tropical preparation' of students continued until the mid-1970's. It was at IC that he met Margaret (Peggy) Godfrey who was also studying Zoology and Applied Entomology. She was to become not only his wife but also his research partner in his professional life. In the final year of his degree studies he was the only one in his year group who had decided on what he was going to do for the compulsory research project, and was three weeks into it, when Professor O.W. Richards had to break the news that his idea had in essence been pre-empted by someone else and was on the verge of publication. Richards, an expert on Hymenoptera, suggested that he develop the classification of Ichneumonidae and that began his work on Hymenoptera. He visited the nearby British Museum (Natural History) (BMNH) for some ideas and returned inspired, declaring that this was the place he really wanted to work.

His first three publications concerned the relatively little-known hatchet wasps and their allies (Evanioidea). The first publication, in 1951, was a portent of substantial works to come; a 50-page paper on *The morphology, taxonomy and biology of the British Evanioidea*. Who publishes such a huge and comprehensive first-paper these days? The second, a taxonomic "generic revision", was not much smaller. Several papers on this group from as far afield as Australia came out over the next decade. Roger graduated from Imperial College with a BSc and an Associate of the Royal College of Science in 1950.

Onchocerciasis or River Blindness caused huge suffering before modern vector control and mass chemotherapy campaigns (Photo: Mectizan Donation Program).

Roger and Peggy Crosskey estimating current flow prior to calculating Didimac (DDT) dosage at a *Simulium* blackfly breeding site in West Africa (Photo: Ian Wollettt)

Fortunately, for the people of West Africa and science, Roger's wish to work in the BMNH was to be delayed when, in 1951, he accepted a post of Entomologist in the Sleeping Sickness Service of the Ministry of Health, Government of Northern Nigeria. UK-based jobs for entomologists were hard to come by in those days. As Tony Duggan reminisced when he learned of his posting to the Sleeping Sickness Service *"I remember the commiserations from those who knew West Africa saying, "Sleeping Sickness? You poor chap". In that job one didn't have a fixed station; one was bush-bound nearly the whole time"* (Reynolds & Tansey, 2001. p.15; Duggan, 1962)

Although based in Kaduna, his function to conduct tsetse surveys took him to many remote parts. At that time onchocerciasis, or River Blindness as it became known, was considered to be an uncommon filarial disease of little importance, carried by an aquatic fly *Simulium damnosum*. Whilst surveying the Galma River valley, Roger became interested in the biting habits of this fly and there he met up with the government ophthalmologist, Frank Budden, who was able to distinguish between onchocercal and other forms of blindness. Budden became convinced that in Nigeria this was a common and economically important disease. Over the next few years Budden surveyed the country plotting the severity of onchocercal blindness whilst Roger, accompanied by his new wife Peggy whom he had married on home- leave in October 1952, surveyed as many rivers as he could for the presence of the vectors. They returned to the Galma river for detailed studies on the bionomics, infection rates and prevalence of onchocerciasis in the human population in an area of over 1,000 square miles. Estimating infection rates with *Onchocerca volvulus* required catching and dissecting thousands of flies in the field, often in quite basic conditions. Anyone who has worked on infection rates of insect vectors in remote areas can testify to the difficulty of obtaining meaningful results under such conditions – there was no liquid nitrogen for transport to a distant laboratory, DNA sequencing for rapid identification, immunoblotting or GPS then. They also undertook basic epidemiological studies on the prevalence of the infection in local human populations. This required taking many thousands of standardised 'skin snips' from people, a not entirely painless procedure, and then, again, examining them quickly in the field for signs of the filarial worms emerging from the human tissue. They must have been very persuasive!

The results of the Budden and Crosskey surveys were published side by side in the Transactions of the Royal Society of Tropical Medicine and Hygiene, clearly showing that wherever the fly was found, so was onchocerciasis. The authorities were persuaded that this was a serious problem and not "an obscure malady unfamiliar to more than a handful of physicians and medical entomologists".

A few of their papers on *Simulium* biology from this time even made it into *Nature*.

Eventually Roger persuaded the authorities to set up a specialised Simulium Control Unit based first at Mina, which later moved to the Emirate Town of Abuja (now Suleja) in 1955, with the objective of determining the extent of the problem and developing a means of control. Perhaps the Crosskeys' most significant contribution was on the control of *Simulium* vectors, especially linking control, not to the abundance of vectors as was the norm at the time, but to the prevalence of disease in humans. They used DDT as a larvicide in the rivers above the breeding sites while also measuring the infection rate in flies and in people. Their work, together with John Davies, was transformational in raising the profile of onchocerciasis to a global health problem and its potential for real control. In a highly perceptive analysis, Bump (2014) wrote "*Perhaps more than any other single effort, the Crosskey-Davies Experiment of 1954-1960 contributed to the scientific and technical basis of this transformation by developing disease transmission monitoring techniques that would serve as standards for the next half century and that local control based on larviciding was unlikely to succeed*". They demonstrated that control of disease, not just flies, was feasible and that because of the biology of the flies, local larviciding initiatives would not control the disease. To the contrary, larger scale, connected, programmes were required. Their work was crucial in underpinning the launch of the multinational, multiagency, Onchocerciasis Control Programme (OCP), led by the World Health Organisation (WHO); perhaps one of the largest biological field studies ever undertaken. That this trio achieved so much with such limited resources is testament to their thoughtfulness, planning and drive and to the freedom that was granted to field officers by the authorities at that time. They could never have done it under today's restrictive conditions.

Apart from regaling his colleagues later in London with affectionate and empathetic tales of colonial days, it appears that for Roger the studies were no more than the expected duties of a professional entomologist in the colonial service. Modesty was a Roger 'trademark'; we never heard the big "I am" that is prevalent among so many high-profile researchers. Perhaps it is why he never received the awards and accolades that befits his lifetime contribution to science.

River blindness was increasingly shown to have an enormous socio-economic impact in many countries of West and East Africa, constraining agricultural and other economic development, and later became a household name as a major endemic disease of tropical Africa. Subsequently, its relatively lesser impact in Latin America was revealed as well as the economic costs of massive black-fly biting rates on forestry, agricultural and tourist development around the world

While still in Nigeria, Roger continued to work on Hymenoptera classification expanding his undergraduate thesis, particularly during periods of 'home leave', and he gained a Masters from the University of London in 1956, and by 1967 he was awarded Doctor of Science for his published work. Their time in Nigeria is described in a fascinating and affectionate book by Peggy Crosskey, *Knotted Round my Heart* (Crosskey,P. 2007).

After eight years in Nigeria, the Crosskeys returned to England in 1959, and Roger took up a position in the Commonwealth Institute of Entomology (CIE) which was hosted by his beloved British Museum (Natural History). His tasks shifted from primarily field-based studies to taxonomic research and identifying insects sent in from around the world by applied biologists investigating agricultural, veterinary and medical entomological problems. This was the *raison d'etre* of the CIE and, it turned out, of Roger himself. During his period with the CIE, later the International Institute of Entomology (IIE), he increased the scope of his taxonomic portfolio to include the Tachinidae, a huge family of parasitic flies of potential interest to biological control of agricultural pests, while also maintaining his burgeoning simuliid work.

From the early 1960s to the mid-1980s Roger devoted much of his research time to the Tachinidae. He was concerned that little taxonomic progress could be made on the vast tachinid faunas of the Oriental, Australasian and the Afrotropical regions because of the over-abundance of generic and specific names and lack of a proper framework for future taxonomic revisions. He set himself an ambitious goal: to "render some order out of the present chaos" by preparing systematic catalogues for the three regions. Through the 1960s he visited major collections around the world to study type material and published papers correcting the nomenclature and synonymy of early authors – a task mostly ignored by later authors. His efforts culminated in the 1970s with publication of three of his greatest tachinid achievements, a revision of the large tribe Rutiliini in Southeast Asia and two comprehensive conspectuses of the tachinids of Australia and the Oriental Region. The *Catalogue of the Diptera of the Afrotropical Region* edited by Roger (see below) followed later in 1980 and updated the Afrotropical Tachinidae. His foray into the Tachinidae ended in 1984 with a key to the genera of tropical and southern Africa, which Roger later regarded as his favourite publication on the family. No other author accomplished so much "order out of … chaos" on this difficult family in such a brief amount of time.

In 1972, Roger transferred seamlessly from the IIE to the staff of the BMNH (later, The Natural History Museum, London) and here he could really take off with his taxonomic ideas. Initially, he joined the Museum as the Head of the Hymenoptera Section, reflecting his significant early contributions, but also to inject some direction to a somewhat disparate team.

Laurence Mound, a former Keeper of Entomology, recalls Roger as a major source of strength to him and to his predecessor Paul Freeman. On entering the Department in 1972, Roger joined a small management group who "dragged the collections into the 20th century" by lightening the dead weight of thousands of store boxes of unsorted insects (accessions) that comprised a major element of the Department's collection into the late 1960's. Such moves, "which included disposal of much unlabelled material of no research value, caused some angst but resistance was met with the quiet persistence that exemplified Roger's style". More junior staff remember the seriousness that he brought to the role of section-head, and a somewhat formal façade behind which one readily discovered a warmth and a caring approach to all those under his guidance.

Perhaps the production of the Afrotropical Catalogue of Diptera best exemplified all aspects of his management skills. Roger saw that the scattered literature across different languages and nations in Africa was a serious impediment to research on a continent with such a range of dipteran-induced problems, including of medical, veterinary and agricultural concern. A team of 40 expert contributors (two-thirds of whom were from the Museum) was assembled and for a decade all names, their synonyms and classification and distributions were synthesised into the one volume catalogue. During the production many research papers were published as the ongoing work encouraged taxonomic revisionary studies. The 'tome' ran to nearly 1,500 pages, including a totally comprehensive bibliography and index. Support tasks, especially the compilation of the 200-page index in a pre-computer era, fell to the entire Diptera section. However, as Paul Freeman recognised in his introduction, the quality and value of work was due to the intense and careful efforts of chief editor Roger Crosskey in insisting on, and meeting, the highest standards of accuracy and consistency.

During this work, Roger introduced the term "Afrotropical Region" to describe more accurately this major biogeographical realm than the outdated "Ethiopian Region" ('a*ethiopian*') of classical origin. This term is now used throughout the world at university level and below – there are very few scientists who can claim such widespread use of their terminology.

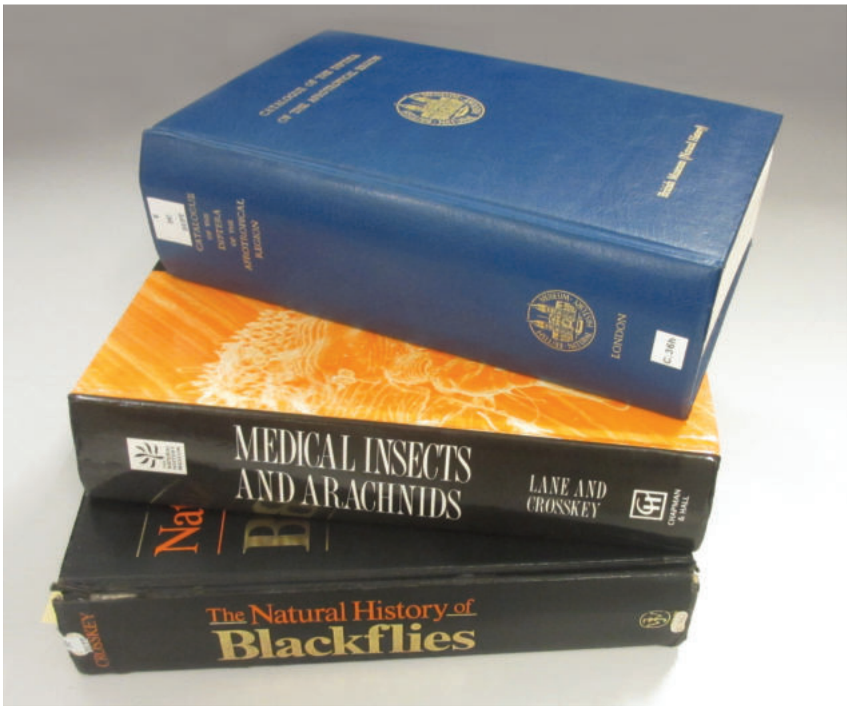
During the 1970's, interest in onchocerciasis exploded with the development of the OCP and consequently Roger became a WHO consultant to various meetings and field programmes in Africa, Geneva and South America to share his knowledge. At the same time, the taxonomy of medically important Diptera was being transformed by the discovery of species complexes – morphologically similar but biologically distinct species. Contrary to what might be expected of a 'morpho-taxonomist', Roger embraced these studies and followed their discoveries closely. He was ahead of his time in being able to integrate the cascade of knowledge coming from genetic and chromosomal research, and later DNA studies, into taxonomy when many of his taxonomic peers shunned these emerging fields. He continued close liaison with key players in the field, such as Prof. Peter Adler, producing a major review on cytotaxonomy (Adler & Crosskey, 2015) in his mid-eighties!

Field work remained a key part of Roger's professional and private life, for many of his and Peggy's holidays were spent foraging for *Simulium* larvae and pupae. Many visitors to Madeira would take strolls along the levadas (watercourses) admiring the spectacular gardens and views. Not so the Crosskeys; they instead collected immature *Simulium* and reared them out in their hotel room. At the NHM, undertaking field work became easier and his forays collecting simuliids or tachinids took him to Argentina, Azores, Brazil, Burkina Faso, Canada (several times), Chile, Madeira, New Guinea, New Britain and Bougainville, Seychelles, Sierra Leone, South Africa, Togo, Uganda and the USA, as well as numerous Mediterranean islands and nations.

Of particular note were the surveys made between 1961 and 2001 to map the distribution of *Simulium* in every watershed in South East England. Some 800 sites were investigated over 40 years. With no google maps, planning for a weekend's collecting required detailed examination of the highest resolution Ordnance Survey maps to identify destinations and plot routes. Such was their modesty, the Crosskeys had to be persuaded to publish the results of this extraordinarily comprehensive study (Crosskey & Crosskey, 2002). Another exemplar of how to do a job properly with planning and limited resources.

It takes a real commitment to a broader public to step away from front-line research and synthesise a concise, yet comprehensive, account of one's academic subject area. Such huge endeavours, for they take an enormous amount of time, are not only scarce in these days of obsessive bibliometric statistics but they also require an ability to stand back and see the subject from the perspective of a more general reader. Roger Crosskey produced several such works, often with trusted partners. The *Afrotropical Catalogue of Diptera* (mentioned above) and the regularly updated *Taxonomic and Geographical Inventory of World*

Roger Crosskey in the Natural History Museum in 1990, the year the much plaudited *The Natural History of Blackflies* was published, having been written on primitive equipment! (Photo: Hiro Takaoka).



Three well used reference works by Roger Crosskey.

Simuliidae (1988 - 2016, various publishers) were reference works with a surprisingly wide readership. The substantial *Medical Insects and Arachnids* (Chapman & Hall,1993) was an edited work with one of his proteges, Richard Lane, then at the London School of Hygiene and Tropical Medicine. Chapters were written by leaders in their field, including such notable medical entomologists and biologists as Mike Service, John Boorman, Tony Jordan, Bob Lewis, Raja Varma and John Cloudsley-Thompson, all with practical experience in the tropics. One of the driving principles of the book was to support field-based workers, a sentiment perhaps best exemplified by the following quote from the introduction "*Many medical entomologists working in the field without access to libraries depend on literature obtained in photocopy or through library loan. Correct bibliographic citation is therefore essential. To meet this need, we have verified* ***all*** *the references cited in the book*.". In fact, "*we*" actually meant Roger, who personally tracked down every one of the references, discovering that more than 70% of the citations had some error, thus justifying his approach. Such was the effort to produce a consistent, accurate and readable account that the two editors concluded that about 50% of the actual words on the page came from them!

Without doubt the greatest of Rogers' syntheses is *The Natural History of Blackflies* (Wiley, 1990). It was a solo and masterly effort. It not only epitomised his style of clear thinking translated into clear and very readable prose, but it was quite simply the complete natural history of a taxon. Reviewers expressed amazement at the breadth and depth of coverage of all facets of the lives and impacts of these insects. Simuliids were brought up to a par with the mosquitoes (Culicidae) in the accessible literature. As ever, reviewers and users also recognised the accuracy and thoroughness of the referencing and indexing (aided by his wife Peggy) that his Museum colleagues had come to expect. It still stands today as an example of how to do the job properly.

Roger will be known always for his extraordinarily high standards of revisionary taxonomy. He was a true master of the field and among only a handful of people to attain this status in the NHM's history. He could blend a broad aerial view of a subject with attention to detail that is crucial in this field; he could see both the forest and the trees. The Simuliidae and the Tachinidae were flies of interest to many scientists – evolutionary biologists, physiologists, ecologists and vector and pest control specialists. He made his work accessible and relevant to them all and was held in great respect across a very broad field. Roger made a lie of the claim by many taxonomists that progress could be made only by working on one, often narrow, group of organisms in a career. He moved between practical and extensive field work on disease control and two different orders of hyper-diverse insects, and then again to two quite different groups of flies, making a major contribution in all these areas.

But Roger also had some curious contradictions. While he was quick to follow the cytological and genetic research on black-flies flowing from such luminaries as Klaus Rothfels' and Peter Adler's labs, he was cautious about new technology. He had to be persuaded in the early 1970's that these new-fangled personal computers really were here to stay and that they could help him produce publications and database his data. This reluctance was not entirely without merit because he was one of the very few people who could compose a manuscript directly onto the typewriter, he did not produce several versions like everyone else, but his clear thinking meant he mostly got it right first time. His manuscripts were ready to go to journals without an editor's red pen in sight. However, he did accept a 'word-processor' to speed up his already prodigious output, and conceded it was indeed a great tool, yet quite remarkably never did have a personal email account, simply relying on the corporate NHM account for professional use!

Roger was not by nature a 'committee man'; he preferred to leave it to others whom he probably felt 'had more time on their hands'. Nevertheless, he did his duty when required. He was a Fellow of the Royal Entomological Society, The Zoological Society of London, and the Royal Society of Tropical Medicine and Hygiene. He was also a council member of the RES for some years and on the Zoological Record Advisory Board for ZSL. He was an active member of various WHO committees and was on the WHO Expert Advisory Panel for Filarial Disease for more than 24 years. His interests in scientific literature took him to the board of BIOSIS (Biosciences Information Services), publishers of Biological Abstracts, and The Zoological Record for the statutory six years. Similarly, he was a strong supporter of the International Trust for Zoological Nomenclature and on their boards and committees between 1987 to 2002. Roger's expertise on zoological nomenclature was legendry and frequently sought by his peers and

Roger examining *Simulium* larvae and pupae in a comprehensive survey of southern Britain in 2000.

junior scientists alike. His profound knowledge of the rules and best practice were tempered with a pragmatic approach: nomenclature had to work to support scientific developments.

Roger was an engaged entomologist and generous with his time and advice. Numerous scientists, students and control programme administrators around the world have benefitted from his sage advice and encouragement.

Roger retired in 1990, at the then statutory retirement age of 60, but continued as he had always done for another 25 years, regularly travelling from his home in north London to the NHM. Even though he became increasingly frail in his final year he still had a 'list' of projects to be completed. Had he spent a little time looking back he should have felt a very genuine sense of accomplishment – a job very, very well done.

The 9th International Congress of Dipterology to be held in Windhoek, Namibia in November 2018 is dedicated to Roger Crosskey in recognition of his contributions to Afrotropical Diptera research.

Personal reminiscences

Roger was a great influence on me, especially in my early career. He was generous with his time and considerable experience and was always very encouraging, sharing his knowledge, contacts and even practical skills. I recall writing a project proposal which I submitted to Roger for approval; he returned it with a sea of red ink in his characteristic small writing. Roger was a very clear thinker and confused or pompous writing was not something he thought highly of! It stood me in good stead for the rest of my career. Outside of the Museum we saw another side of him. He was very amusing and had many anecdotes of his early career in West Africa. We enjoyed his company enormously. He was always greatly respected and was affectionately known as "Uncle Roger" by the Diptera section staff.

Working together with him on "*Medical Insects and Arachnids*" was a wonderful experience, and one of the highlights of my career. I was at the London School of Hygiene and Tropical Medicine, and Roger at the Museum, when he approached me to work jointly on the project. It was a huge task, something Roger had undertaken before when compiling both multiauthor works and his own substantial publications. When I later became Keeper of Entomology, I often consulted Roger on a new idea I had. He was not always behind the idea, but he always put a frank and cogent point of view which usually meant the idea was modified. He had a great affection for the Museum and the valuable work it undertook and was keen that this should not be diluted. I am very proud to have had Roger as a mentor, professional colleague and, especially, as a friend.

Richard P Lane

A brash juvenile of the sixties acknowledging as a key mentor the 'colonial era' entomologist Roger Crosskey, who graduated from Imperial College in the year I was born, may seem unusual. Roger and I overlapped for a decade in the Diptera Section (later Diptera and Medical Insects) of the British Museum (Natural History). As I recall, I succeeded him as the section head when senior personnel such as Roger were liberated from administration to 'write what they knew' before retirement. Naturally Roger was getting on just fine managing his staff with a light touch, with prolific publication and world-wide collaborations unimpeded.

I reflect on his influence in several ways. He wrote beautifully and fluently and, in the politest way, encouraged others to do so: he always found time to discuss effective communication. Roger argued by words and actions that we 'owed' it to our funders that we should publish what we study and make it available in appropriate and timely manner. This meant engaging with 'applied' entomology even for taxonomists of the more obscure and intransigent insects. In a highly anticipatory way, Roger calculated a precursor of bibliographic metrics in assessing publication rates of those he considered to be top scientists in their fields. He identified a goal of '3-5 primary papers per year' plus book chapters, edited volumes and even complete books, a target that has stayed with me across my career.

Other interests of Roger's concerning practical issues that influenced me then included identification of the 'mihi itch' (self-promotion by describing new taxa with little or no justification) and the ratio of genera to species in our two major research groups (tachinids and chironomids) and what this implied regionally and across the globe. These calculations derived from his curiosity about what became called 'biodiversity studies', albeit constrained by availability of underlying data.

In all these matters Roger was ahead of contemporary thought, and I thank him for being so.

Peter S Cranston

Although Roger and I were both in the Department of Zoology at Imperial College (then known as I.C.) he was two years ahead of me specialising in Entomology whilst I specialised in Parasitology, so our paths seldom crossed. It was not until I accepted a post of Entomologist in the Sleeping Sickness Service of the Ministry of Health of the Government of Northern Nigeria (filling a post that he had vacated, I later discovered) that I came to know him. In February or March 1955 I was living together with another tsetse control officer in a tented camp near a small tsetse infested river about 14km from Gboko in Benue Province where we were conducting some insecticide control trials. Roger and Peggy visited us one day whilst on their country-wide *Simulium* survey. They were seeking local knowledge on any likely breeding rivers. During the course of the day we visited a nearby steam where they collected specimens and introduced me to the mysteries of *Simulium* larvae and the varied forms that the pupae take. Their enthusiasm was infectious and I was hooked. When Roger obtained his long hoped for appointment to the CIE, I was offered the chance to take over Roger's *Simulium* Control Unit and accepted like a shot, beginning my career as a *Simulium* controller. Considering our long association of over 60 years, we only met briefly every two or three years at meetings, conferences and occasional visits to the BM, and I think two or three visits to his home. However, Roger kept up a lively correspondence with me in my varied overseas appointments, and I could always turn to him for sound advice. Over the last 30 years Roger was an enthusiastic supporter and contributor to the Bulletin of the British Simuliid Group (a body which he helped to found). I will greatly miss our fortnightly phone conversations on a wide range of subjects.

John B Davies

Acknowledgements

We are very grateful to Peggy Crosskey for background information, especially on Roger's early life; to Laurence Mound, former Keeper of Entomology at the NHM, for his insights into Roger's work in the NHM, and to James O'Hara, Canadian National Collection, Ottawa and Daniel Whitmore (NHM) for information on his impact on Tachinid research.

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A complete Simuliid bibliography has been published as a Supplement to Issue No. 49 January 2018, of The Simuliid Bulletin.. at URL; http://simuliid-bulletin.blogspot.co.uk in the Archives section. or at https://drive.google.com/open?id=1E12yZi87tMlX94RthxL7HSpifPPz4uor

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.

MEETINGS OF THE ROYAL ENTOMOLOGICAL SOCIETY

National Insect Week 2018

18-24 June, 2018

http://www.nationalinsectweek.co.uk/

Insect Rearing Special Interest Group

26 June, 2018

Registration and tea & coffee from 09:30.

Inaugural meeting of this new special interest group, wil be held at Syngenta, Jealotts Hill International Research Centre, Bracknell, Berks, RG42 6EY

Invertebrate Rearing and Insectary Management

Convenor: Gary Needham gary.needham@syngenta.com

Keynote speaker: Clive Farrell Hon. FRES

Insect Conservation Special Interest Group

27 June, 2018

Conservation of the Swallowtail in Britain

A joint meeting of the Swallowtail and Birdwing Butterfly Trust and the Royal Entomological Society Conservation Special Interest Group, hosted by the Ted Ellis Trust

Location: Wheatfen Broad Nature Reserve, Ted Ellis Trust, Surlingham, near Norwich, NR14 7AL

Registration is now closed as we are fully booked, contact Kirsty Whiteford kirsty@royensoc.co.uk, if you would like to be added to waiting list.

Convenors: Alan Stewart a.j.a.stewart@sussex.ac.uk, Mark Collins mark@sbbt.org.uk

Eastern Region Meeting

12 July, 2018

Starting Small, Aiming Big - Insect Conservation on local nature reserves.

This day long joint meeting of the Royal Entomological Society (Eastern Region) and A Rocha UK aims to bring together those interested in insect conservation and the value of local nature reserves. It will consist of a series of invited talks during the morning and then a field trip to see an example reserve. Foxearth Meadows Nature Reserve, which opened in 2017and is run by A Rocha UK. Conservation on the reserve is focused in particular on dragonflies and damselflies and despite being only a small site 21 species of Odonata have been recorded there.

Location: Clare Town Hall (CO10 8NN), and the field trip to Foxearth Meadows Nature Reserve (CO10 7GA)

Speakers:
Guy Manners (Butterfly Conservation)
Alvin Helden (Anglia Ruskin University/Royal Entomological Society)
Andy Lester (Conservation Director, A Rocha UK)
Mark Prina (Reserev Manager, Foxearth Meadows Nature Reserve, A Rocha UK)
Pam Taylor (British Dragonfly Society)

Contact: Alvin Helden alvin.helden@anglia.ac.uk

Ento '18

August 29-31, 2018

The good, the bad and the ugly.

Edge Hill University, Ormskirk

Convenors: Anne Oxbrough , anne.oxbrough@edgehill.ac.uk , Clare Strode clare.strode@edgehill.ac.uk

Advancement in the field of entomology is frequently driven by a variety of factors beyond scientific exploration and interest, from ease of sampling and identification or the favouring of more 'charasmatic microfauna' to difficulties in obtaining resources required for specialised field or laboratory techniques or funding bias. This conference seeks to address this by providing a platform for areas of entomology that are often overlooked or understudied and discussing what can be learned from these groups.

Plenary speakers
Professor Stefan Scheu - Georg August University Göttingen
The Good - Below ground goodies: Ecology and evolution of soil microarthropods

Professor Richard Wall - Bristol University
The Bad - Ticks and tick-borne disease

Dr Jason Dombroskie - Cornell University Insect Collection
The Ugly - Yes that's nice...but look at this! Challenges of generating interest in and relevance to the non-charismatic microfauna

Professor Lin Field, Rothamsted Research
Aphids as vectors of crop diseases

Insect Genomics Special Interest Group

14 September, 2018

Venue: University of Leicester

Convenors: Hollie Marshall hm257@leicester.ac.uk and Katherine Beadle k.beadle@exeter.ac.uk

Keynote speaker: Yannick Wurm, Queen Mary University https://wurmlab.github.io

Twitter: #EntoGenomics2018

Abstract submission is now open, please email abstracts to resgenomics2018@gmail.com. 250 word limit, please indicate if you would like to present a talk or poster. The deadline for abstract submission is Friday August 31st at 5pm.

Insect Data Special Interest Group

23 October, 2018

Venue: University of Hull

Comparative analyses across multiple species are a crucial tool for understanding biodiversity loss and resilience in the face of global change as well as evolution and adaptation. This kind of analysis requires curated data from many species as well as a phylogeny linking those species. Unfortunately, efforts at compiling such data for insect and other arthropod species lag behind similar efforts for vertebrates and plants. While many independent resources exist (such as databases and recording schemes) that catalogue various arthropod traits, e.g. ecological habitats, distribution and occurrence, there remains a need for efforts to coordinate these various resources in a centralised, user-friendly way, via e.g. shared protocols, structures and ID tags, and for researchers to integrate these data easily into their workflows.

The proposed Special Interest Group would bring together curators of independent resources with researchers and professionals interested in using comparative arthropod data - to present resources, and discuss and establish common data requirements and protocols. The project is intended to be ongoing as new resources emerge and are linked to the project, and greater integration is achieved. In the short term, one anticipated outcome is that participants are all simply more aware of, and familiar with, the existence, availability and protocols of various insect data resources. This in itself may likely lead to several new data-related collaborations. In the medium term, the resources themselves might be adapted to reflect agreed shared protocols, encouraging transparency and standardisation, and harmonizing the process of data retrieval from multiple resources. In the longer term, a steering group formed from members of the SIG might aim to create a central meta-platform linking through to the various resources to make integrated analysis much easier and to make these data more widely available to researchers from a wide array of disciplines.

Convenor: James Gilbert, james.gilbert@hull.ac.uk

Orthoptera Special Interest Group

7 November, 2018

Venue: Neil Chalmers Room, Natural History Museum, London

Convenor: Björn Beckmann orthoptera@ceh.ac.uk

Everyone is very welcome to attend the annual Orthopterists' meeting of the Royal Entomological Society, whether to present research or just to listen and meet others. The next meeting will be held on Wednesday 7th November 2018, 13:00-17:00, in the Neil Chalmers Room in the London Natural History Museum followed by drinks and a cold buffet. Please email Björn Beckmann at orthoptera@ceh.ac.uk if you would like to present a talk, suggest a speaker, or bring a poster or display.

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, Website/App 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

www.royensoc.co.uk

Royal Entomological Society
– Society Awards –

For more details on these Society Awards please see www.royensoc.co.uk

THE ROYAL ENTOMOLOGICAL SOCIETY STUDENT AWARDS

Award Criteria: Any article about an Entomological topic that would be of interest to the general public. The article to be easy to read, in a popular style and no longer than 800 words.

Prize: Winner £400, runner up £300, third place £200, all three articles published in *Antenna*.

THE LJ GOODMAN AWARD FOR INSECT BIOLOGY

Award Criteria: For advancing the education of the public in the knowledge, understanding and appreciation of all aspects of insect physiology and behaviour, thereby promoting the control and conservation of insect species.

For promoting research into aspects of insect physiology and behaviour through online, digital or printed material.

For supporting exhibitions, meetings, lectures, classes, seminars and courses that widen the understanding of insect physiology and behaviour.

Grant: No individual award shall exceed £3,000 and not more than £6,000 shall be awarded each year.

THE MARSH AWARD FOR INSECT CONSERVATION

Award Criteria: For an outstanding contribution to Insect Conservation; on the basis of 'Lifetime Achievement', or 'Considerable and Exemplary Contribution' to a significant project or undertakings. In exceptional circumstances two prizes may be awarded to reflect each criterion.

Prize: £1250 and Certificate.

POSTGRADUATE AWARD: THE ALFRED RUSSEL WALLACE AWARD

Award Criteria: For post-graduates who have been awarded a PhD, whose work is considered by their Head of Department to be outstanding. The research involved should be a major contribution to the Science of Entomology.

Prize: £800 plus Certificate, plus one year's free Membership. The winner will also be invited to present their work at a Society Meeting.

JO WESTWOOD MEDAL – AWARD FOR INSECT TAXONOMY

Award Criteria: The best comprehensive taxonomic work on a group of Insects, or, related Arthropods (including terrestrial and freshwater Hexapods, Myriapods, Arachnids and their relatives). Typically, this will be a taxonomic revision or monograph.

Prize: A specially struck silver gilt medal inscribed with the winners name. Also costs incurred in attending the International Congress of Entomology, European Congress of Entomology, or other major meeting (specified by the Adjudicators) to present his/her work.

RES JOURNAL AWARDS SCHEME

Award Criteria: The best paper published in each Society Journal over a two year period. Each of the Society Journals participate biennially.

Prize: £750 and Certificate for each participating Journal.

THE WIGGLESWORTH MEMORIAL LECTURE AND AWARD

Award criteria: The outstanding services to the science of Entomology. The award will be made to a researcher who has contributed outstanding work to the science and who best reflects Sir Vincent Wigglesworth's standards of personal involvement in every aspect of his/her research.

Prize: A specially struck gilt medal inscribed with the winners name. Also the costs of attending the International Congress of Entomology to give the Wigglesworth Lecture.

BOOK PURCHASE SCHEME FOR FELLOWS AND MEMBERS IN DEVELOPING COUNTRIES

Award Criteria: To provide assistance in purchasing specialist Taxonomic books, that will assist in the identification of Insect groups being studied in developing countries and their regions. Applicants will be required to demonstrate need and specify particular texts.

Prize: Any one applicant may be awarded up to £250 in a three year period. The Society will purchase the texts awarded and send them to the applicant. The applicants may, themselves, provide any additional funds in excess of the amount awarded.

OUTREACH AND CONFERENCE PARTICIPATION FUNDS

Award Criteria: ORF: Grants to support activities which further the Society's aims. This may range from, help to purchase equipment, to help in funding expeditions/meetings. CPF: Grants to assist applicants who are participating in a meeting or conference in some way, e.g. presenting a paper/poster.

Prize: ORF: Monetary grant. CPF: Monetary grant.

MARSH AWARD FOR EARLY CAREER ENTOMOLOGIST

Award Criteria: For an early career contribution to Entomological Science that is judged to be outstanding or exemplary with single or ongoing impact on the science. The Award is 'open' and not restricted to any particular discipline or specialised area of entomological science.

Prize: £1250 and Certificate

Royal Entomological Society
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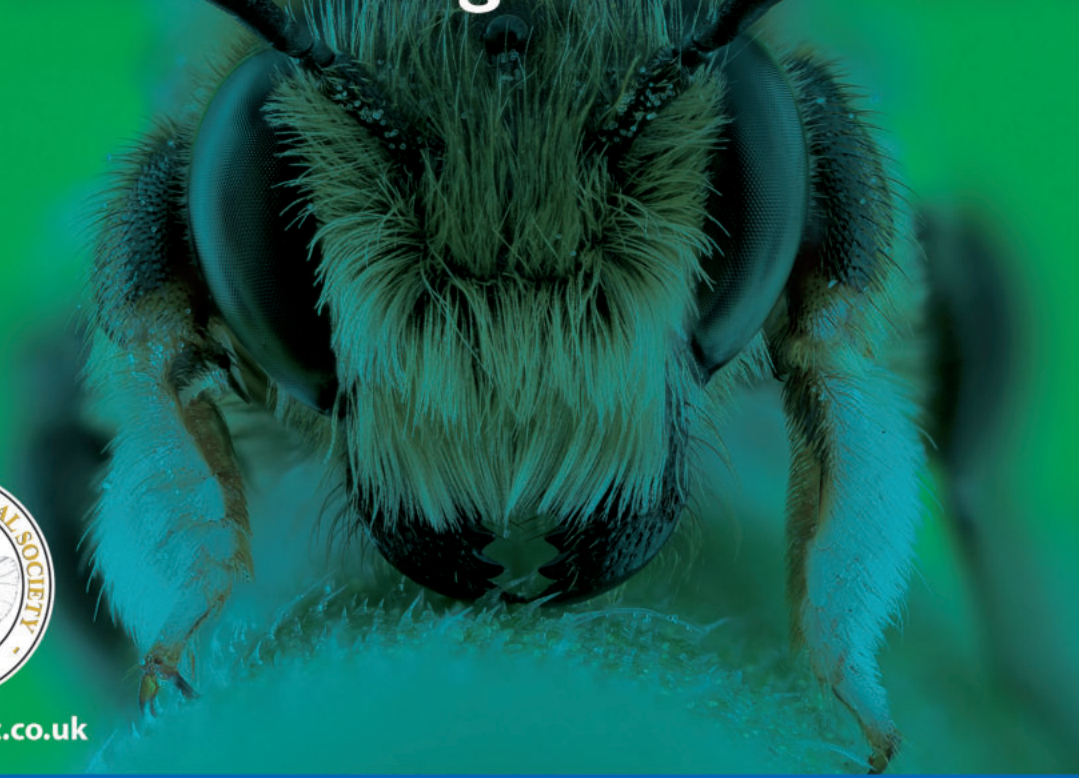
Tel: +44 (0)1727 899387 • Fax: +44 (0)1727 894797
E-mail: info@royensoc.co.uk

RES STUDENT AWARD 2018

Write an entomological article and WIN!



www.royensoc.co.uk

REQUIREMENT

Write an article about any Entomological topic that would be of interest to the general public. The article must be easy to read and written in a popular style. It should be no more than 800 words in length.

WHO CAN ENTER?

The competition is open to all undergraduates and postgraduates, on both full and part-time study.

PRIZES

First Prize: A £400 cheque and your article submitted for inclusion in *Antenna*.

Second Prize: A £300 cheque and your article submitted for inclusion in *Antenna*.

Third Prize: A £200 cheque and your article submitted for inclusion in *Antenna*.

ENTRIES

You can send electronically via e-mail to: kirsty@royensoc.co.uk

Alternatively, complete the attached entry form, and submit it with five copies of your entry to:

The Registrar,
Royal Entomological Society,
The Mansion House,
Chiswell Green Lane,
St Albans, Herts
AL2 3NS

For further information telephone: 01727 899387

Please include:

- Your name and address (including postcode)
- Your e-mail address
- The name and address (including postcode) of your academic institution
- Evidence of your student status

THE JUDGES

The judges panel will be made up of three Fellows of the Royal Entomological Society. The judges decision is final.

CLOSING DATE

The closing date for entries is 31 December 2018. The winner will be announced in the Spring 2019 edition of *Antenna* and on our website.

PLEASE CUT AND RETURN THIS PORTION WITH YOUR ENTRY

Article title: ______________________

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Student name: ______________________

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Address: ______________________

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Telephone: ______________________

E-mail: ______________________

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Name of academic institution:

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