Bulletin of the Royal Entomological Society Volume 39 (2) 2015

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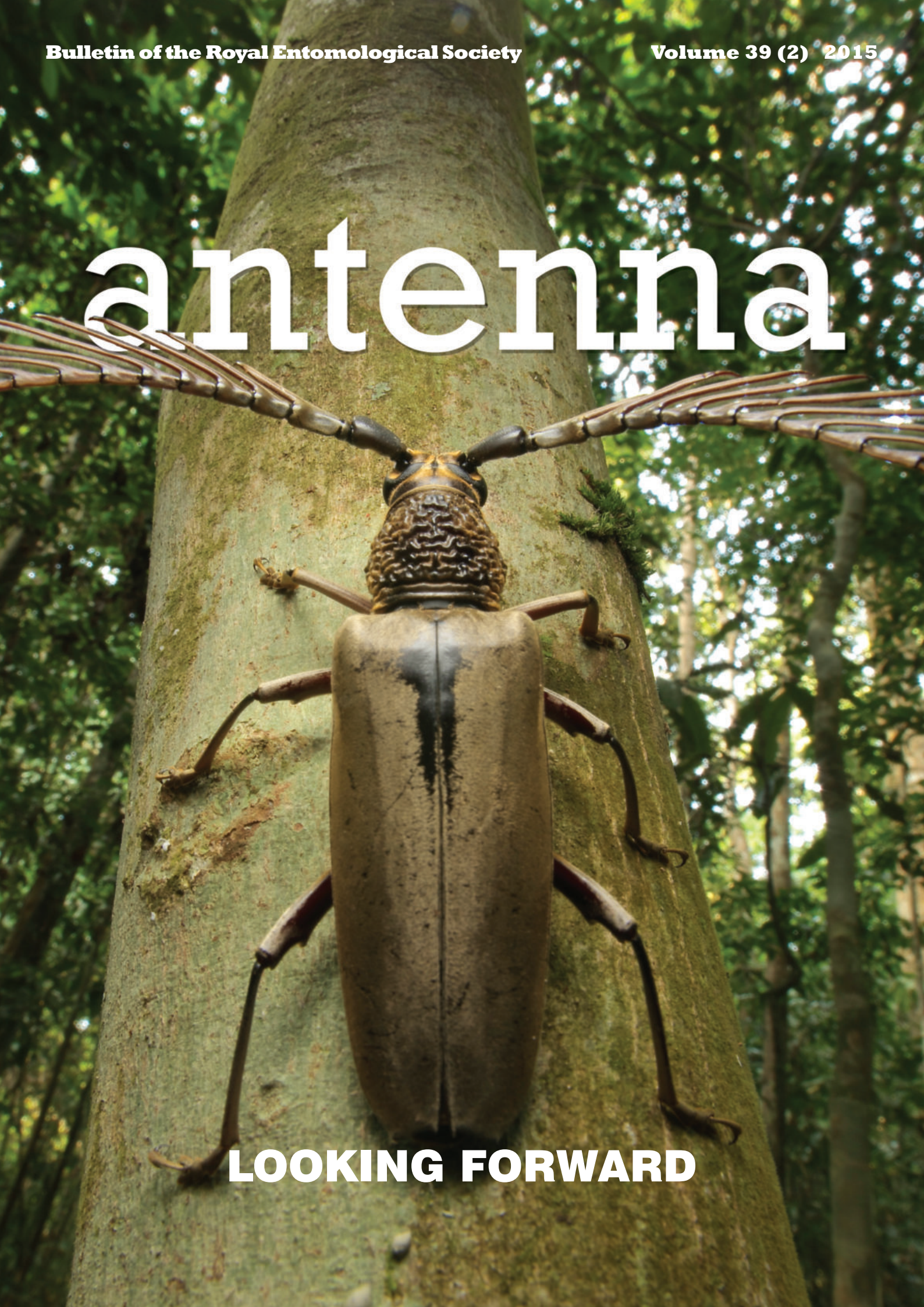
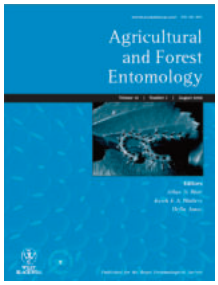
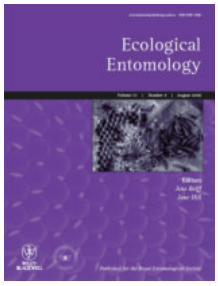
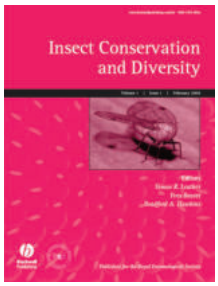
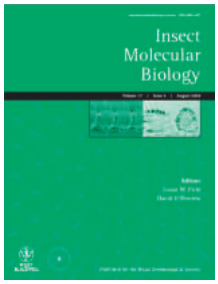


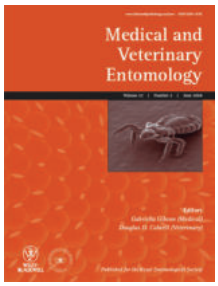
LOOKING FORWARD

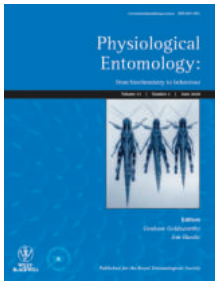


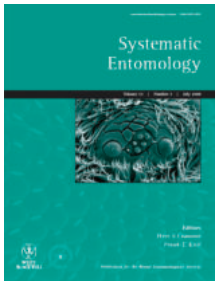












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The Royal Entomological Society
The Mansion House,
Chiswell Green Lane, Chiswell Green,
St. Albans, Hertfordshire AL2 3NS
E-mail: **antenna@royensoc.co.uk**

Editors:
Peter Smithers
(University of Plymouth)
and
David R. George
(Stockbridge Technology Centre)

Editoral Assistant:
Jennifer Banfield-Zanin

Consulting Editor:
Prof Jim Hardie

Assistant Editors:
Adam Hart (Outreach)

Business Manager: Registrar

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The Mansion House, Chiswell Green Lane,
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Tel: 01727 899387 • Fax: 01727 894797
E-mail: info@royensoc.co.uk

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EDITORIAL

Hello and welcome to *Antenna* 39(2).

Looking back to the last issue of 2014, we hope you've retained your 3D glasses in a safe spot. In response to Alan Shaw's piece on 3D imaging, Tom Hartman provides this issue with the most visually impressive Correspondence we've received for some time, along with a note on the further benefits of 3D SEM technology to entomological science.

Contrary to looking back, for those field entomologists among us this is often a time for looking forward to another season's sampling. Indeed, by the time this issue lands on your door mat or appears in your pigeon hole, Jen and I will already be well underway with 2015 field projects at Stockbridge Technology Centre. Looking forward to the future is also a theme that runs through much of this issue.

Throughout my career I've been involved with several studies that have concentrated on the use of 'multi-functional' flowering field margins to promote insects and related ecosystem services; one of which will be highlighted in the not-too-distant future at Ento'15 (for the impatient more information can be found here: www.ecostac.co.uk). These margins should be making a colourful and functional contribution to the agricultural landscape by the time this issue is released, and colour and function are the subjects of R.D. Dransfield and R. Brightwell's article, in this instance as applied to aphids. This article has an element of the 'looking forward' too, suggesting numerous interesting directions for future research in the field of insect coloration. The same can be said for Richard Kelly's contribution on the collections at Bristol Museum and Art Gallery, a seemingly forgotten treasure trove of entomology awaiting future discovery by the dedicated researcher or keen amateur entomologist.

Educating and engaging the next generation of entomologists, or the public at large, is key to ensuring the future of insect science and the theme of several articles in this issue. Dr Anne Duplouy describes her work at the University of Helsinki to promote the role of the "researcher" amongst visiting school children, using entomology as a vessel to intrigue and entertain young audiences. The RES's own Dr Luke Tilley provides a review of National Insect Week 2014, and though the theme may have featured the adjective 'little', by all accounts it was the biggest NIW yet! In addition to a report on the week's activities from Luke, this issue also features the results of the 2014 NIW Photography Competition, courtesy of competition organiser and past RES president Prof Chris Haines.

Royal Entomological Society initiatives such as NIW are increasingly benefitting from the broad reach of social media, and it seems the same can be said for regular meetings. As Dr Mark O'Neill notes in his summary of the last Technology and Computing SIG, social media not only raised awareness prior to the meeting, but also generated significant interest afterwards, including from the BBC. When it comes to 'looking forward' this SIG is particularly pertinent and Mark's overview of the meeting includes tantalising glimpses of new technology that could significantly change the way many of us collect data, myself included. This Issue also includes details of new SIGs recently endorsed by the RES in an offering by Dr Archie Murchie on 'How to Hold a Royal Ent Soc Meeting'. Archie also provides an overview of the last Verrall Lecture, delivered by Prof Sue Hartley on the fittingly forward-thinking subject of pest control using natural plant products.

Also in this issue's Society News are a report on the 2014 Ant Course by PhD student Adam Devenish, results of the 2014 Student Essay competition, and a report on the last Postgraduate Forum. The quality of research and writing presented here suggests that, looking forward, the future is certainly bright for the next generation of entomologists. The same can be said for entomology in the North of England, with Dr Gordon Port providing details of a series of planned meetings, events and training opportunities, many of which will be made possible with support from a new Heritage Lottery Fund project.

David George

Guidelines for submitting photographs

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

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

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

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

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

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

300dpi

72dpi

CORRESPONDENCE

3D anaglyphs

It was interesting to read Alan Shaw's article on 3D anaglyphs of arthropods. The images are both dramatic and engaging and provide a way in to lots of different conversations. My colleague, Alex Hyde, and I have been teaching 3D imaging on the University of Nottingham's MSc in Biological Photography and Imaging course and there is one aspect of these images that was missing from the article and that is that they can reveal detail that is unavailable from any other source. I include a shot of a zebra spider *Salticus scenicus* that we were investigating (the crumpled eyes are a vacuum artefact). This portrait shot shows that there are five large, sensory hairs that project outward from the head of this animal. Other than using a 3D SEM there is no way of determining this feature. The positioning of these hairs would not be detected by any other means. There may be other areas of research where such an imaging technique could reveal critical positional information.

With best wishes,

Tom Hartman
Keeper of the Zoology Collection,
Microscopy and Image Analysis
The University of Nottingham

Climate change and bugs down under

Dear Editor,

Thank you to Dr Chris Reid for his remarks on my article "Climate change and bugs down under" that appeared in *Antenna* and for pointing out a mistake regarding the species name I provided for eucalypt leaf beetle. Unfortunately Dr Reid did not contact me prior to sending his letter and has inadvertently added to the confusion. I am just writing now to clarify the matter. The species I meant was *Paropsis atomaria** which is not the same as *Paropsisterna* spp., which Dr Reid was referring to. I apologise for the mistake, which was mine alone. I interviewed ten people in New Zealand and Australia for the article and somewhere along the line I wrote the wrong species down. Apologies again – not taxonomic disregard but sloppy note taking in this instance!

Will Hentley
Department of Animal and Plant Sciences
University of Sheffield

*Those interested should see a brand new paper on this species by Andrew (interviewed for the *Antenna* article) and others: Gherlenda, A., Haigh, A.M., Moore, B.D., Johnson, S.N. & Riegler, M. (2015) Responses of leaf beetle larvae to elevated [CO_2] and temperature depend on Eucalyptus species. *Oecologia*, Online early, DOI: 10.1007/s00442-014-3182-5.

Colour in aphids – Aposematic, cryptic or both?

R.D. Dransfield and R. Brightwell

InfluentialPoints.com

Introduction

We receive many requests for aphid identification, especially in May and June when aphids are on young growth. Requests are fewer in October, but 2014 brought a request plus photos from Nigel Gilligan in Cumbria for identification of a striking red aphid. It turned out to be crimson tansy aphid (*Uroleucon tanaceti*) feeding on tansy. Nigel was impressed by their bright appearance and odd distribution, 'widely scattered looking almost like sentries'. The bright red colour and the behaviour of the aphids strongly suggested warning coloration. But a literature search revealed these aphids are usually hidden on leaf undersides - not at all 'right' for an aposematic display. So Nigel embarked on a mini-study of crimson tansy aphid behaviour - and we decided aphid colour would make an excellent topic for an illustrated article.

Mechanisms of colour production

The colour of aphids results from pigmentation of the haemolymph (termed ground colour), melanism of the cuticle (termed surface colour) and waxy exudates. The ground colour is mostly produced by two distinct groups of pigments, aphins (technically known as polycyclic quinones) and carotenoids such as beta-carotene, lycopene and torulene. These two pigment types are able to produce a great range of colours in aphids, from the familiar blacks and greens of 'blackfly' and 'greenfly' to reds, yellows and gold in less well known aphids.

Aphins were initially identified and characterised by Lord Todd and his co-workers (Duewell *et al.*, 1948). They included protoaphin, which is responsible for the dark colours present in for example the elder aphid (*Aphis sambuci*) (Fig. 1. left) and aphinin,

Fig. 1. (left): *Aphis sambuci* (elder aphid) adult and nymphs on *Sambucus nigra* (elder). (right): *Macrosiphum rosae* (rose aphid) adult green form on *Dipsacus fullonum* (teasel).

Fig. 2 (left). *Uroleucon tanaceti* (crimson tansy aphid) adult on *Tanacetum vulgare* (tansy); Fig. 3 (right). *Macrosiphum rosae* (rose aphid) red form colony on *Rosa* sp. (rose).

Fig. 4. : *Delphiniobium junackianum* (monkshood aphid) on *Aconitum napellus* (monkshood). (left): adult and nymphs. (right): colony spread over leaf.

which occurs in the green morph of the rose aphid (*Macrosiphum rosae*) (Fig. 1. right). We should perhaps emphasise at this point that green aphids don't acquire their green colour from chlorophyll. There is no chlorophyll present in the phloem upon which aphids feed.

Aphins also produce some more dramatic aphid colours. For example the yellow pigment (neriaphin) found in the oleander aphid (*Aphis nerii*) (see Brown *et al.*, 1969) is a quinone pigment, as is the red pigment of the red goldenrod aphid (*Uroleucon nigrotuberculatum*), named uroleuconaphin (Horikawa *et al.*, 2006). Although it has yet to be characterised, we suspect that the red pigment in *Uroleucon tanaceti* (Fig. 2.) is uroleuconaphin, or closely related to it.

Many aphids also have red carotenoid pigments. Carotenoids are coloured compounds mostly produced by plants, fungi, and microorganisms which are required in the diet of most animals for oxidation control or light detection. The colour of the red form of *Macrosiphum rosae* (Fig. 3) is most likely produced by a carotenoid pigment.

Until recently it was assumed that all the carotenoid pigments in aphids were either sequestered from plants or from intracellular symbionts. But then Moran & Jarvik (2010) unexpectedly found that the pea aphid (*Acyrthosiphon pisum*) genome itself encodes multiple enzymes for carotenoid biosynthesis. Phylogenetic analyses showed that these aphid genes are derived from fungal genes, integrated by horizontal gene transfer into the aphid genome and duplicated (GM protesters, take note).

Whilst it now seems that carotenoids in aphids are not sequestered from plants, this may be the case for the vivid turquoise pigment in the monkshood aphid (*Delphiniobium junackianum*) (Fig. 4). Its host plant, *Aconitum napellus*, is a highly toxic garden plant which was popularised for the painful disposal of unwanted relatives in the much-watched, though

Fig. 5. *Cinara pini* (Scots pine aphid) adult and nymph on *Pinus sylvestris* (Scots pine).

not to our taste, British television programme "Midsomer Murders". The pigment responsible for the colour of *Delphiniobium junackianum* has yet to be identified, but one possible candidate is an anthocyanin sequestered from the host plant (Shamim *et al*. 2014). The anthocyanin present in the purplish blue flowers of *Aconitum chinense* is known as violdelphin (Takeda *et al.*, 1994).

Conventional wisdom dictates that structural colours are not present in aphids (van Emden & Harrington, 2007). Nevertheless several *Cinara* species such as *Cinara pini* (Fig. 5) display a bronzy iridescence which is most likely derived from structural components of their cuticle.

So what is the adaptive significance of colour in aphids?

Colour does have important consequences for body temperature, and in some insects is important in mate recognition. But probably the most important use of colour is as a defence against predators. For this purpose coloration can be described as aposematic (warning) or cryptic (camouflage) - or in some cases both!

How does aposematic coloration work?

The function of aposematic coloration is to make the aphid highly conspicuous to potential predators so that it is noticed, remembered and then avoided - assuming, that is, the predator finds the experience sufficiently unpleasant. In terms of a life history strategy, aposematism is at the opposite end of the spectrum to crypsis - cryptic aphids try to make themselves very inconspicuous to predators.

Given that these initial encounters tend to kill the 'teachers', which cannot therefore reproduce, the mechanism by which aposematism evolves may not be immediately obvious. However, the parthenogenetic nature of aphids means that members of an aphid colony are all very closely related. Hence aposematism will be adopted through kin selection - in other words the teacher attempts to ensure the survival of its own genes by benefiting closely-related individuals.

Assuming an aphid wants to be seen by predators, what characteristics are important?

According to Prudic *et al.* (2007) two important factors are high chromatic (colour) contrast, and high luminance (brightness) contrast. Among insect predators, insect larvae (such as coccinellid and syrphid larvae) have simple eyes with single ocelli and therefore cannot see colour (to discriminate colours requires at least 2 types of ocelli, each sensitive to a different wavelength). Hence high luminance contrast, as well as behavioural characteristics, will be the main factor.

Wax stripes, in a colony of the elder aphid *Aphis sambuci* (Fig. 6.) are a good example of high luminance contrast. Elder aphids contain toxic compounds, such as cyanoglycoside sambunigrin, which produce hydrocyanate (prussic acid) when consumed by a predator. Hence, to any predatory insect larvae which survives the experience, the wax

Adult insects have compound eyes and therefore can see colour, although the majority are only bichromatic - they have just two types of colour pigment receptors, which limits their ability to differentiate colours. Conversly, the spectral range of colours visible to insects is somewhat broader than for humans because, although most insects cannot see red, they can see in the ultraviolet part of the spectrum. Daylight hunting spiders appear to have several types of colour pigment receptors, as do vertebrate predators such as birds and lizards.

The crimson tansy aphid (*Uroleucon tanaceti*) is an excellent example of an aposematically-coloured aphid. It would appear crimson to insectivorous birds (which have colour vision), but black to insect predators and grazing cattle. We have never found this aphid ourselves, but Nigel Gilligan (one of our regular contributors from the north of England) sent us some really nice photos of it earlier this year. Mehrparvar *et al.* (2013) established that predatory coccinellid and chrysopid larvae could not complete their development on this aphid species. *Uroleucon tanaceti* feeds on tansy (*Tanacetum* spp.) which contains a volatile oil containing thujone, camphor and myrtenol. It seems likely that the crimson tansy aphid acquires its toxic or unpalatable nature by concentrating some or all of these compounds. If so, adult aphids may be much more distasteful than young ones.

When Nigel first spotted these aphids, they were spaced out in a near regular pattern of dispersion on the upper surface of the leaves (Fig. 7). All of these were adults. Further examination revealed that most of the colony (including all the young) were on the undersides of the leaves (Fig. 8. left). This may explain the apparent 'mystery' noted by Heie (2009) of an aposematic prey living concealed from sight. It seems reasonable that adults on the leaf topsides are especially distasteful 'sacrificial lambs' which predators might take (and then regret), thus ensuring that the great majority of the colony remained untouched. If the adults on top of the leaf are post reproductive, this would be an added benefit.

So why has this 'sacrificial lamb' behaviour not been observed before?

On a repeat visit to the colony, following some wet weather, Nigel found that all the aphids were on the

Fig. 6. *Aphis sambuci* (elder aphid) colony on *Sambucus nigra* (elder).

Fig. 7. *Uroleucon tanaceti* (crimson tansy aphid) adults showing regularly dispersed pattern on *Tanacetum vulgare* (tansy).

Fig. 8. *Uroleucon tanaceti* (crimson tansy aphid) colony on *Tanacetum vulgare* (tansy). (left): adult and nymphs on underside of leaf. (right): adult leaving upperside of leaf after spraying with water.

Fig. 9. *Cinara curvipes* (bow-legged fir aphid) displaying deimatic behaviour on *Abies* (fir).

Fig. 10. (top): Winged *Hyalopterus pruni* (mealy plum aphid) on *Prunus domestica* (plum). (bottom): *Cinara kochiana* (giant larch aphid) showing cryptic coloration on trunk of fallen *Larix* (larch) tree.

undersides of the leaves. Since rain is recognised as an important cause of aphid mortality, it is reasonable for them to use the leaf undersides as shelter during rain. So we suggested a simple experiment: spraying the adult aphids with water. Sure enough, a light sprinkle of water produced a rush for cover (Fig. 8. right). It seems their display is weather dependent.

Dixon (1958) considered that aphid species can be divided on the basis of spatial pattern into two groups. One group comprises sedentary, clumped, aposematically coloured, toxic and/or ant-attended aphids. The second group is made up of mobile, more randomly dispersed, and cryptic aphids. However, Dixon's reasoning clearly does not work for *Uroleucon tanaceti*. It is a highly mobile aphid, but toxic and aposematic. Moreover, as we see below, the developing nymphs of aphids such as *Cinara confinis* are cryptically coloured, but feed in large sedentary groups.

Some aphids augment aposematic displays using deimatic behaviour, a term used for any threatening or startling behaviour - such as the sudden display of eyespots by moths - designed to highlight aposematic coloration. In aphids the 'leg kicking' response of several *Lachnus* and *Cinara* species is a good example of deimatic behaviour. Figure 9 shows this behaviour by, the invasive, bow-legged fir aphid (*Cinara curvipes*).

Disturbance appears to provoke the behaviour, but the posture may be held long after the source of the disturbance has passed. Some authors have suggested this posture is used to elicit feeding (honeydew removal) by ants - which, in turn, avoids sooty mould growing on honeydew around their colony.

How does cryptic coloration work?

Given the apparent vulnerability of aphids to predators, one would expect cryptic coloration to be a widely employed strategy. And indeed, as Dixon (1997) points out, most of the aphids that live on leaves are green, whilst those that live on the woody parts of the plant are brownish. This form of colour matching is termed homochromy and is very common with aphids. Figure 10 (top) shows the superb crypsis of adult winged mealy plum aphids (*Hyalopterus pruni*) on plum leaves. Figure 10 (bottom) shows the equally good cryptic coloration of the giant larch aphid (*Cinara kochiana*) on the dying branch of a fallen larch tree.

Note that photographing examples of crypsis is a frustrating affair because, if your subject is good at concealing itself, it will not show up well in your photo! These examples demonstrate not just colour matching but also texture and pattern matching, and all ages of aphids from the youngest nymphs to the adults are cryptically coloured. But this is not always the case.

In some *Cinara* species there is aposematic coloration in the adults, but cryptic coloration in the nymphs. Figure. 11 (left) shows three aposematically coloured adults of the black-stem aphid (*Cinara confinis*) together with a large group of their nymphs which have classic disruptive camouflage coloration.

Similarly, adult alates of the hairy willow bark aphid (*Pterocomma*


Fig. 11. (left): C*inara confinis* (black stem aphid) adults with cryptic nymphs. (right): *Pterocomma pilosum* (hairy willow bark aphid) winged adult with nymphs on *Salix fragilis* (crack willow).

Fig. 12. Mixed species colony of black willow bark aphids (*Pterocomma salicis*) and hairy willow bark aphids (*Pterocomma pilosum*) on willow.


Fig. 13. *Macrosiphoniella absinthii* (absinthe aphid) colony on *Artemisia absinthium* (wormwood). (left): close-up. (right): distant shot.

pilosum) are strongly striped and very conspicuous, whereas their nymphs are cryptic and often very difficult to spot (Fig. 11 right). It certainly makes sense for aposematic coloration to be delayed until the adult stage, if it takes time for the aphid to sequester sufficient chemicals from the host to make it distasteful or poisonous. Provided predators do not come to associate the very conspicuous (and presumably distasteful) adult with a nearby group of more palatable nymphs, then those nymphs will benefit from both reduced predation pressures and by partaking in a nutrient sink with their adult(s).

The mixing together of cryptic and aposematic forms is taken a step further by bark aphids when they form multispecies groups. Both the nymphs and the wingless adults of *Pterocomma pilosum* are cryptic, but they regularly form mixed colonies (Fig. 12) with the aposematic black willow bark aphid (*Pterocomma salicis*).

By so doing *Pterocomma pilosum* would seem to lose any possibility of camouflage on the bark. Perhaps the aposematic 'message' 'rubs off' on the cryptic species, and predators learn to leave the mixed species assemblages alone - or perhaps they only notice the aposematic aphids.

Cryptic or aposematic or both?

The first thing one notices in a close-up picture of the absinthe aphid (*Macrosiphoniella absinthii*) (Fig. 13. left) is its dramatic black and white coloration. Given that the chemicals from the foodplant (absinthe) are likely to be distasteful, this would seem an obvious case of aposematic coloration for defensive purposes.

However, if we step back a bit (Fig. 13. right), we realise it could be a form of crypsis: either pattern blending in amongst the flower head, or disruptive coloration where a block of highly contrasting coloration and sharp boundaries prevent a predator from detecting or recognizing the prey's outline (Caro, 2009). Or could it have a dual function as Ruxton (2002) suggested for zebra stripes - cryptic when aphids are amongst the flower heads in low light, and aposematic when exposed on the flower heads? A striking example of this can be seen in Fig. 14. Up-close and personal (Fig. 14. left) these giant willow aphids (*Tuberolachnus salignus*) are anything but cryptic, but seen *en masse* (Fig. 14. right) the effect is entirely different.

Fig. 14. *Tuberolachnus salignus* (giant willow aphid). (left): close-up of adult on *Salix cinerea* (sallow) showing dorsal tubercle. (right): long shot of colony on *Populus tremuloides x P. tremula* (hybrid aspen).

Willink *et al*. (2013) tackled this issue for the polymorphic granular poison frog (*Oophaga granulifera*). This frog has multiple colour morphs, which range from a bright red dorsal colour (aposematic) to a green dorsal colour (cryptic) - with everything else in between! Populations of intermediate colours attain intermediate conspicuousness by displaying different combinations of aposematic and cryptic traits. Hence there is a continuum between cryptic and aposematic strategies.

And what about red-green polymorphisms?

Since academic interest in aphid colour has focused almost exclusively on red-green polymorphisms, we will end with this topic.

In our September blog (Dransfield, 2014) we reported our discovery of a previously undescribed colour form of the green-striped fir aphid (*Cinara pectinatae*). Once this aphid has found a suitable feeding site, it does not move very much, and is well anchored by means of its strong claws. Normally it relies on its green and white cryptic coloration (Fig. 15. left) to protect it from bird predators such as the coal tit (*Periparus ater*).

In September this year we found a reddish-brown form (Fig. 15. right) of the same species in Bedgebury Pinetum. These brown forms were just as well camouflaged as the green forms - except they were mimicking buds, rather than needles. The reddish-brown colour may be produced by a

Fig. 15. C*inara pectinatae* (green-striped fir aphid) on *Abies procera* (noble fir). (left): normal green & white form resembling needles. (right): brown form resembling buds.

Fig. 16. *Acyrthosiphon pisum* (pea aphid) on *Lathyrus odoratus* (sweet pea). (left): adult green form. (right): fourth-instar red form.

Fig. 17. (left): *Sitobion avenae* (English grain aphid). (left): green form adult and nymphs on leaf of *Avena sativa* (oats). (right): reddish-brown form nymphs on leaf of *Triticum* sp. (wheat).

carotenoid pigment as in other better known red-green polymorphisms, or it may come from an erythroaphin. The polymorphism between these two forms is presumably maintained by the relative availability of buds and needles - the red form seems to mainly occur in autumn after bud development in the summer (Andrea Binazzi, pers com., recalled finding brown forms in late summer and autumn, but did not publish this observation).

It has proved more difficult to establish the biological significance of other red-green polymorphisms in situations where the red morph has no obvious cryptic value. The pea aphid *Acyrthosiphon pisum* (see pictures of green and red form below) has been extensively studied.

This polymorphism appears to be maintained by balanced selection from two natural enemies - the predatory ladybird *Coccinella septempunctata* and the hymenopteran aphid parasitoid *Aphidius ervi*. Losey *et al*. (1997) found that when parasitism rates were high relative to predation rates, the proportion of red morphs increased relative to green morphs. The converse was true when predation rates were high relative to parasitism rates. Detailed laboratory and field studies confirmed that green morphs suffer higher rates of parasitism than red morphs, whereas red morphs are more likely to be preyed on by predators than green morphs are. Quite *why* there are these differences is less clear.

The English grain aphid (*Sitobion avenae*, Fig. 17.) also displays a red-green polymorphism which is determined both genetically and in response to environmental factors (Jenkins *et al.*, 1999). In this case the biological significance of the colour polymorphism is unknown, although seasonal changes occur in the frequency of colour morphs in the field.

The sycamore aphid (*Drepanosiphum platanoidis*) also displays a variety of colour forms both with respect to the degree of pigmentation of bands on the cuticle and the ground colour. Winged adults of the spring and autumn generations (Fig. 18. top & bottom) have black bands on their abdomen and are darker in color than the summer generation (Fig. 18. middle). In addition some aphids from mid-summer onwards have a red-brown ground colour (Fig. 18. bottom). Dixon

Fig. 18. *Drepanosiphum platanoidis* (common sycamore aphid) winged adults on *Acer pseudoplatanus* (sycamore). (top): green form with well marked cross bars. (middle): pale summer form. (bottom): red-brown form with reduced cross bars.

Fig. 19. *Myzus persicae* (peach-potato aphid) red, green and orange adults and nymphs on *Salvia*.

suggests that the increased melanization in spring and autumn enables the aphids to maintain a higher body temperature at times of year when temperatures are normally low. The adaptive significance of the colour change is less clear.

An important pest aphid species, the peach-potato aphid (*Myzus persicae*) also has two main colour forms, green and red (Fig. 19.), although in some populations colour varies rather more from whitish-green, to orange, to red. The different colour forms are again determined both genetically and environmentally, and have been linked to various physiological characteristics, including susceptibility to insecticides (Kerns *et al.* 1998). Thermoregulation has again been proposed as the benefit of colour polymorphism in *Myzus persicae*.

Whilst it can be hard to explain the ecological significance of (the very widespread) red-green polymorphism, it is next to impossible to explain some of the aberrant colour forms found in large aphid populations. The most dramatic colour form we have encountered so far is a golden-yellow form (Fig. 20.) of the poplar shoot aphid (*Chaitophorus populeti*).

Most of the aphids on just this one aspen sucker were golden-yellow patterned with orange and black, with a few of the typical green and brown forms scattered amongst them. Such aberrations are most likely the result of random mutations, and are soon lost from the population if they offer the aphids no selective advantage. Nevertheless, given their parthenogentic reproduction, many aphid colonies are effectively clones, so under favourable conditions individual variation can be hugely amplified.

Acknowledgements

Our especial thanks to Nigel Gilligan for his photographs of *Uroleucon tanaceti* and *Delphiniobium junackianum* and to Christoph Rieckmann for his photograph of the group of *Tuberolachnus salignus*. We are also grateful to Roger Blackman for suggesting that we submit this to Antenna for publication, and to the Forestry Commision for providing access to Bedgebury Pinetum and permission to sample.

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Fig. 20. *Chaitophorus populeti* (poplar shoot aphid) golden-yellow & normal green-brown forms on *Populus tremula* (Aspen). (left): winged adult and nymphs. (right): nymphs.

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Figure 1. Poster of the "Science goes Kindergarden" project. Pre-school children are invited to visit the University of Helsinki and discover Biology and meet with researchers. Questions such as "What do butterflies do during winter? Do plants get sick? What do caterpillars eat? What is a pipette? Or what do pupae do?" found their answers through different ateliers.

Children experience Science

Dr. Anne Duplouy

Department of Biosciences,
The Metapopulation Research Centre,
The University of Helsinki,
00790 Helsinki, Finland
e-mail: anne.duplouy@helsinki.fi

In the last two years, researchers from the Metapopulation Research Centre (MRC) at the University of Helsinki, Finland, have, under the initiative of Dr. Anna-Liisa Laine, introduced more than 150 pre-school children to Biological Science and the profession of 'researcher'. The project is called "Tiede Tulee Tarhaan" in Finnish, which translates into "Science goes Kindergarden" (Figure 1). The project consists of groups of three to four children from the same class rotating between six to seven ateliers (workshops) over the course of one morning. Each morning starts with a short presentation from each researcher present on the day, including their name and nationality. There is then time for a few questions and definitions. What is a University? Who works at the University? What do researchers do? Children often have interesting answers for each of those questions. Finally, the children are introduced to the different science ateliers.

The MRC researchers have been investigating the biology of species inhabiting fragmented landscape since 1992. Their model species include, but are not restricted to, the Glanville fritillary butterfly (*Melitaea cinxia*), its parasitoid wasps (*Hyposoter horticola*, *Cotesia melitaearum*), its host plant (*Plantago lanceolata*) and its parasitic fungus (*Podosphaera plantaginis*). The ateliers presented to the children were, at first, mostly focusing on those few species, but evolved with time to introduce other species and systems, including earth-worms, dung-beetles and bacteria. Each atelier is very much hands-on, the children can observe, touch and ask any question to the researchers in charge.

One of the ateliers focuses on the Glanville fritillary butterfly. It presents the different stages of the butterfly life cycle: the live larvae still eating their host plant, a few immobile pupae and their silk allowing them to stick to a support, the adult butterflies flying inside their cage. Children are also asked to identify the female and male individuals based on their wingspan. They are offered wings preserved under transparent plastic films, the larger wings are from females. Sometimes the size difference is difficult to observe, so children and researchers then discuss other ways to tell the different sexes apart.

Fifteen minutes have passed and it is time for the first rotation, the next atelier brings the children to the laboratory. Before entering the lab, children and adults must put on a lab-coat. Then they can sit at the bench and learn how to manipulate a pipette for mixing solutions. Children are taught that this is one of the tasks the researchers sitting at the next bench are currently doing. Their solutions are, however, not as colourful. This is no easy task, but kids seem to enjoy the hard work, and they show their excitement for the colourful results. Questions are asked; everyone wants to know something more, something different. Laughs and serious looks are exchanged. What is coming next? Indeed, it is again time to rotate.

The next atelier may be the "plant-parasite" or the "bacteria" and an opportunity to look under a microscope, or the "earth-worms" or "seed planting" and a chance to get all hands dirty with soil, or perhaps the "dung-beetles" atelier and the possibility to use forceps to try and order those scarabids by size.

My own very first memory of a Biology class was when I was 10 years old. I remember a hot spring school day. The sun is shining in the room, the air is warm and filled with the smells of wood, black ink and chalk. I am standing with my classmates around a large aquarium tank, placed on the last table of the classroom. It is not filled with water but with branches covered in green fresh leaves. I look more carefully, more intensely, and finally I can spot a couple of those green and black caterpillars. I am fascinated: they are eating the leaves so fast! They are also so much bigger than yesterday! Of that particular day, I also remember being very impatient. We had been following the growth of those caterpillars for some time and I was aware they would be soon changing into pupae and then into butterflies. I knew this because our teacher had given us a lesson earlier in the week presenting the life cycle of butterflies. I could not wait to witness the different stages, and to finally release the adult butterflies into the wild. When I take part in the "Science goes Kindergarden" project I can therefore understand these children's accumulated excitement when lunchtime comes; when it is time to go back to the bus and then back to their classroom. I can imagine that the topics of their conversations will remain the same for a little longer. They will be conveying everything they have learned at the University with those researchers in white lab-coats to their parents and siblings at diner tonight, maybe over the entire week or weekend. Hopefully their next drawing will be a butterfly, a plant parasitized by a fungus or a shiny beetle.

I can only hope that the children's enthusiasm will grow with time, and that their answer to the classic question "what do you want to be when you're a grown-up" will be "a researcher". Simply because research is ("cool") exciting, at least that was what I thought and is still what I think! Initiatives such as the one launched by Dr. Laine at the University of Helsinki should be encouraged, for our young and curious children to discover Biology. Because our role as researcher is not only to test hypotheses through different sets of experiments, but also to communicate our results to our peers, the scientific community and to the general public, so everyone may know what happens behind the doors of our universities.

Figure 1: Insects that live in sand dunes in the South-West England local area. A) Butterflies, B) Hawkmoths, C) Other insects.

Detour to the West Country: Bristol Museum & Art Gallery

Richard Kelly
richard.kelly.nh@gmail.com
@Worldwide_Richi

In the last article of this series I wrote that this issue would be based on a visit to Birmingham Museum & Art Gallery. Unfortunately, however, I was not able to visit Birmingham due to untimely meetings, timetable clashes and site maintenance. As a result I will be visiting Birmingham in a future article to discuss their collections. Instead we take a bit of a detour into the West Country for this installment to visit Bristol Museum & Art Gallery at the suggestion of the curator. In the previous articles we visited the Cole Museum of Zoology in Reading and the National Museum Cardiff. Both were good examples of the importance of different kinds of museums. The Cole being a small university museum whose collections were a snap-shot of early 20th century zoological collecting, and the National Museum Cardiff (NMC) being at the other end of the scale as a large multi-discipline museum, holding and still actively collecting specimens as part of the UK's dispersed national collection.

Bristol Museum & Art Gallery is based in the south-west of England and, similarly to Birmingham, is an example of a museum run by local government. The museum took residence in its current building following the Second World War after the original building, which is now a Brown's restaurant, was severely damaged during the Bristol Blitz. The blitz took place in 1940 and destroyed much of the city as well as the museum. Many of the collections at the museum were lost and many of the records relating to those that had survived were also destroyed. The building to which the collections were moved was the once Wills Art Gallery, and the collections were stored in the basement on a promise of a new bespoke museum building being developed. However, as the years went by this became less and less likely and instead the art gallery ceded the lower parts of the building to the museum and so the Bristol Museum & Art Gallery was born.

As with many museums that share facilities with art galleries there are difficulties in relaying the importance of natural science collections to visitors primarily interested in other disciplines, and there often seems to be a struggle between the arts and natural sciences. With budgets being cut and squeezed it has never before been so important to highlight the importance of natural science collections for the scientific community and for the general public. Bristol Museum seems to play its part in this very well, with a range of activities designed to draw people into the collections and a curation team dedicated to advocating those collections for scientific research and public education. One member of the team and the resident entomology curator is Rhian Rowson, who I spoke to during my visit to learn about the insect collections and about how the museum does its part in garnering interest in them.

Collections on Display

There is no dedicated entomology section at Bristol Museum, unlike those at the Cole Museum and NMC, but there are insect displays written in amongst the other specimens. There is an extensive entomology collection hidden away in the stores underneath the museum, but the damage inflicted

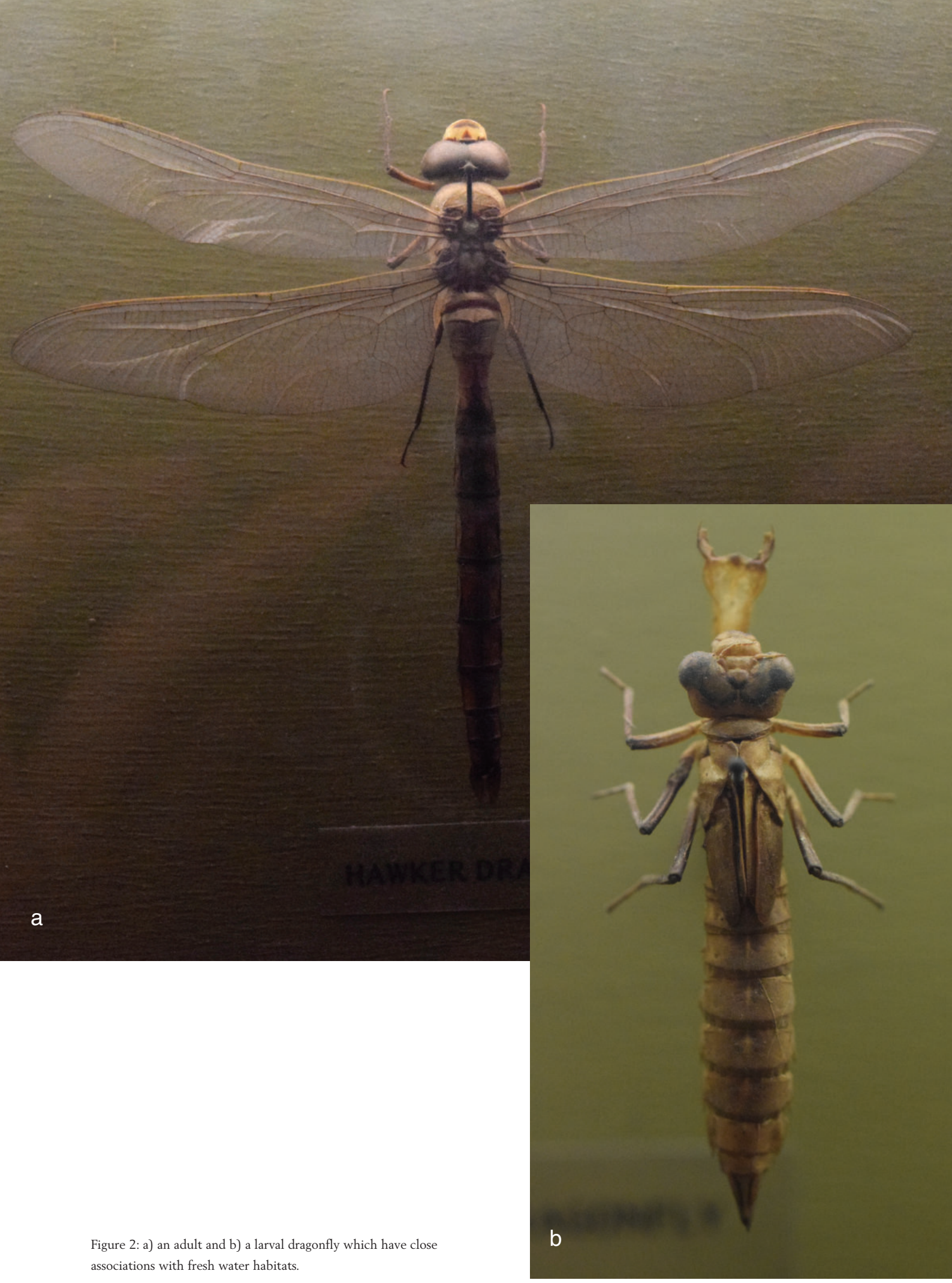

Figure 2: a) an adult and b) a larval dragonfly which have close associations with fresh water habitats.

Figure 3: Great diving beetles (*Dytiscus marginalis*) are voracious predators in freshwater systems and swim near the bottom searching for tadpoles and small fish.

during the Second World War has had a lasting effect, preventing these specimens from being displayed to the public.

South West Natural History

This gallery takes a look at the natural history of the wetlands local to Bristol. There are several displays showing the range of flora and fauna found in the local area. Insects were represented by those that live in or around sand dunes (Fig. 1a-c), similar to the display at NMC. The display tells us that sand dunes provide ideal conditions for many groups, including grasshoppers, beetles, butterflies and hawkmoths. The focus is largely on disturbance of these areas by visitors, both in cars and on foot, and how this drives many animals away.

Further around the gallery there is another display relating to aquatic insects, including examples of adults and larvae that live in fresh water habitats. Specimens of some of these are on display, including both adult and larval dragonflies (Fig. 2a&b), great diving beetles (Fig. 3) and, one of my personal favourites, whirligig beetles (*Gyrinus spp.*) (Fig. 4). There are also large, brightly-lit macro photos showing certain examples in more detail (Fig. 5a-c). Similarly to NMC, I enjoyed the mixture of real life specimens and large colourful photos to draw visitors to the display.

Figure 4: The whirligig beetles (*Gyrinus sp.*) is known for its frantic dancing on the surface of the water utilising a bubble of air it carries under its elytra.

World Wildlife Gallery

Next I came to the World Wildlife Gallery; unfortunately the British Wildlife Gallery was under renovation during my visit. I'm told, however, that it will be finished by April and will be an amazing new feature, definitely worth a visit to see. The World Wildlife Gallery displays many interesting animals from around the globe, grouping specimens by the continent they live on. However, the focus of this section is largely on mammals and birds with only a small display case of insects (Fig. 6). This almost seems to have been included more for decorative purposes than education value, with very little information accompanying the display. Apart from a couple of large beetles the display is entirely Lepidoptera and from an entomological perspective I would have preferred to see a bit more variety.

Insects in Mythology

Alongside the natural science collections at Bristol Museum there is a rather splendid exhibition about Ancient Egypt which touches on the importance of insects to the old Egyptian ways. A local archaeology student, Scott Gouldsbrough, expanded on the information in the collection, informing me about the importance of insects to the ancient Egyptians and their mythology. There were several insects important to Egyptian religion, including scarab beetles and bees. The way in which the scarab larvae emerged 'spontaneously' from the ground led the Egyptians to associate the beetles with the god Atun, who himself was self-creating. Their image was believed to be a powerful symbol of eternal life and resurrection and a heart scarab talisman was often placed over the heart of a mummified person; it was thought that the scarab would protect the wearer during the post-life weighing of the heart (Fig. 7). Bees were also sacred. It was believed that they descended from the tears of the sun-god Ra as they landed on the Earth, and that they bridged the gap between the natural world and the underworld. The bee became a symbol of kingship (Fig. 8) and honey became part of the cross-over process into the next life, with jars of honey being buried in tombs to aid the soul of the departed in their journey. Butterflies, grasshoppers and praying mantises were also held in high regard and believed to act as guides to the deceased on their journey to the underworld.

Figure 5: Examples of some of the macro photographs on display which illustrate the features of the specimens in a more easily accessible way. a) Larva of the great diving beetle (*Dytiscus marginalis*), b) Adult great diving beetle enhancing the real life specimen, c) Adult mosquito (*Culex pipiens*) emerging from its pupal stage.

Figure 6 (left): The only tropical insects on display were restricted to a very small display case with little information relating to the specimens; Figure 7 (right): Scarab beetle talisman often found covering the heart of an entombed mummy.

Figure 8: Bees were sacred to Ancient Egyptians and often represented kingliness.

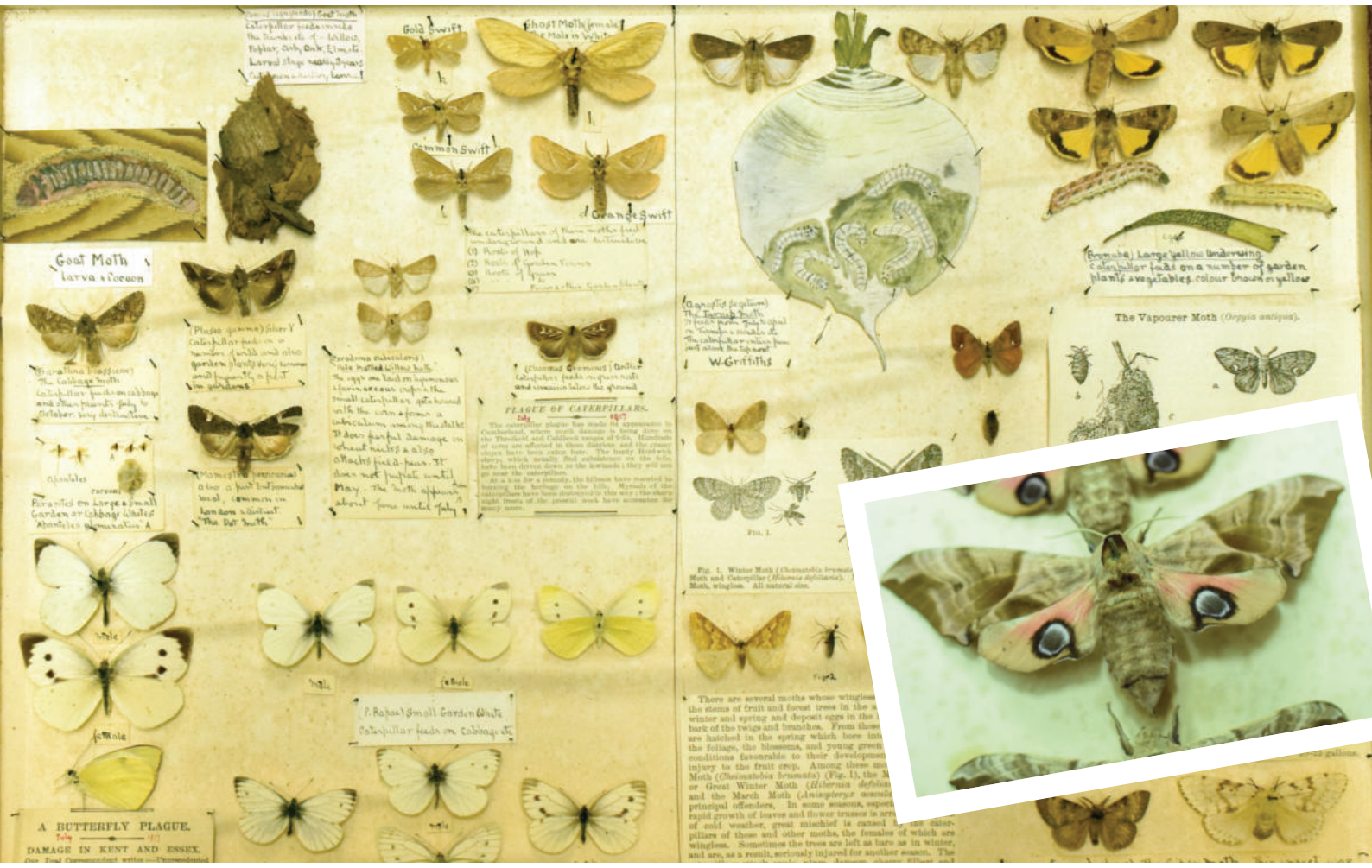

Figure 9a (top): An example of the many Lepidoptera collections is I.R.P. Heslop's collection of world Lepidoptera. Seen here are some of the more than 150 specimens of purple emperor (*Apatura iris*); Figure 9b (top, inset): Another example is the stunning G.C. Griffiths collection which comes with an abundance of additional information relating to the specimens; Figure 9c (bottom): The Braikenridge collection holds many fascinating specimens including a large collection of hawkmoths (Fig 9d; bottom insert).

Figure 10: The Colopetera collections have been amalgamated into one World Coleoptera museum collection and have some stunning specimens from around the world. a) Harlequin beetles (Cerambycidae: *Acrocinus longimanus*), b) Tropical Scarabaecidae, c) Rhino beetles (Dynastinae).

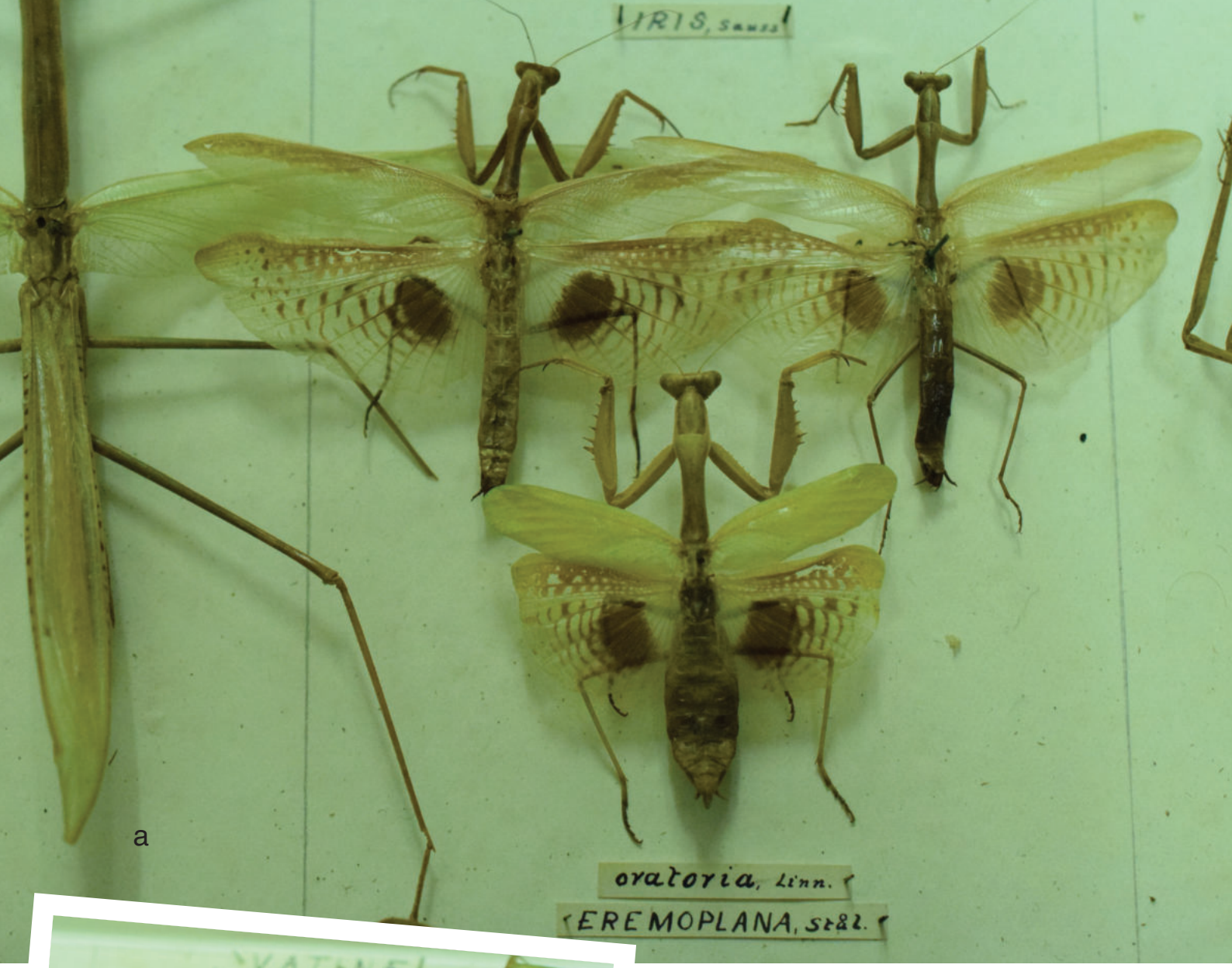

Figure 11: Examples of Mantodea: a) Tarachodidae: *Iris oratoria*. b) Mantidae: *Stagmatoptera praecaria*.

Figure 12 (above): Examples of Hemiptera: a) Cicadidae: *Polyneura ducalis*, b) Largidae: *Macrocheraia grandis* (labelled under its synonym: *Lohita grandis*).

Figure 13 (left): The Diptera curation project is ongoing at the museum as with, for example, the Bombyliidae (bee-flies). Original collection of L.F. Audcent shown.

Figure 14: Hermaphrodite small skipper butterfly (*Thymelicus sylvestris*).

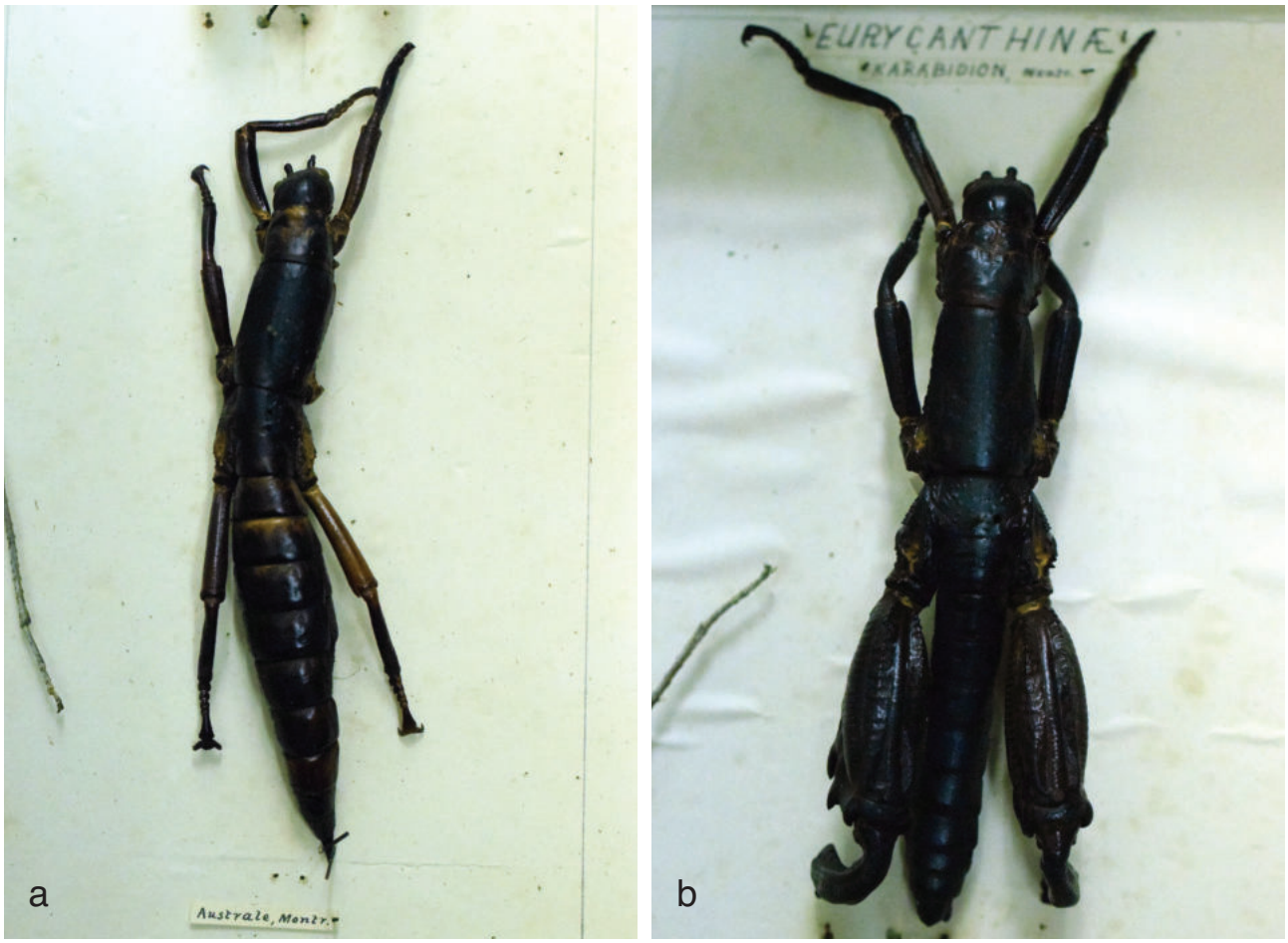

Figure 15: Lost type specimens can be found again by rummaging through old museum collections like these *Dryococelus australis* female (a) and male (b).

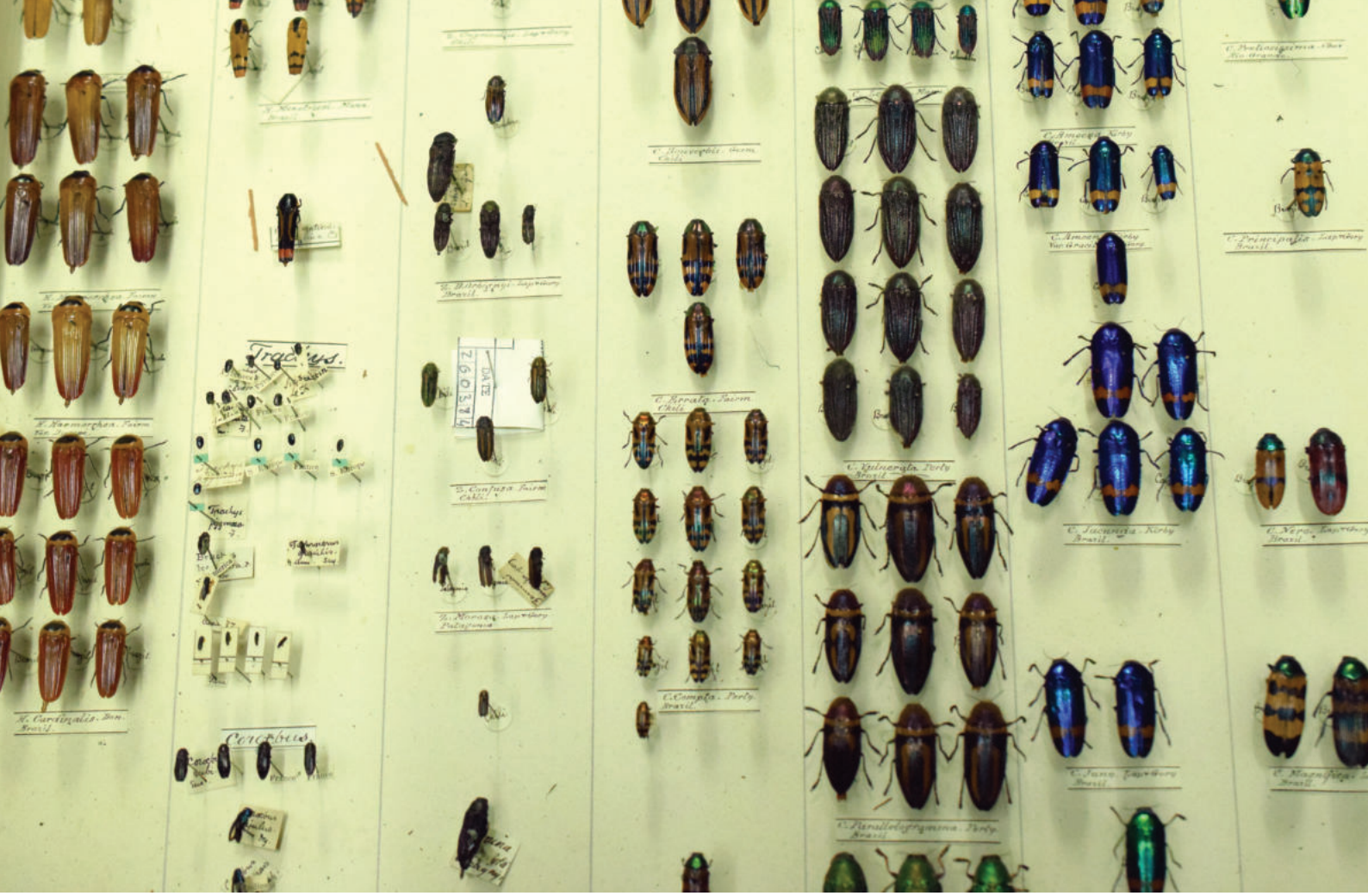

Figure 16: Bartlett collection of tropical beetles.

Behind the Scenes

The entomology collection at Bristol consists of approximately 400,000 specimens. It is particularly strong in Lepidoptera (Fig. 9a&b) and Coleoptera (Fig. 10a-c), but also holds many Diptera and Hymenoptera. There are also examples of Phasmotodea, Mantodea (Fig. 11 a&b), Hemiptera (Fig. 12 a&b) and Odonata. Specimens are largely still stored within their original collections and often within the original cabinets they were donated in, similarly to the Cole Museum. However, there are current efforts to amalgamate these disparate collections into one coherent collection by taxonomy, much as we saw at NMC in the last article. Part of this process is developing reference collections which will allow visiting researchers to see all of the species available in the museum stores without having to search through the collection cabinets to find them. This will streamline the research process and will hopefully open up the stores even further for people to use.

Diptera Project

There is an ongoing project at the museum to curate the large Diptera collection in the way described above (Fig. 13a&b). The project began in 1999 with the Syrphidae (hoverflies) and has now moved into other families including Bombyliidae (bee flies), Sciaridae (fungus flies), Conopidae (thick headed flies), Tabanidae (horse flies), Tipulidae (crane flies) and Asilidae (robber flies). The work is largely carried out by volunteers overseen by Rhian Rowson and aided by specialists in Diptera taxonomy, including a national hoverfly recorder and a national expert on crane flies. The project has led to the development of workshops in Dipteran taxonomy which are held at the museum.

Interesting specimens

There are many important collections and specimens at Bristol Museum which over the years have helped develop our understanding of the British entomofauna. Prior to the Blitz the entomology collection had been described as the most important outside of the British Museum. One example is the H.J. Charbonnier collection of Diptera and Hymenoptera, which was donated to the museum in 1906 and has been used to develop lists of local species. Another important collection, which was transferred from the University of Bristol in 1983, is the L.F. Audcent collection of around 3,000 British and European Diptera specimens (for example: Fig. 13a), many of which are local to the South-West of England. These two collections, amongst others, are currently being amalgamated under the aforementioned Diptera Project.

During the tour of the collections one specimen that Rhian pointed out as being particularly impressive was an example of a hermaphrodite small skipper butterfly (*Thymelicus sylvestris*) (Fig. 14). Male patternation can be seen on the butterfly's right wing, but is missing from its left wing which depicts the female patterning. This specimen is figured in Frohawk (1938).

The importance of advertising and permitting access to the museum's stores never becomes more apparent than when a visiting academic finds something in the collection that nobody knew was there. Rhian tells me about a visiting academic from Bristol Zoo whose passion is entomology. After spending some time in the stores working with the museum's Phasmatodea collections he realised that two specimens of the Lord Howe Island stick insect (*Dryococelus australis*) were actually the male and female types which had been lost for some time (Fig. 15a&b). Bristol Museum's stores are a treasure trove waiting to be explored

and unlocked. Since the war left the collections in such disarray, there are surely many more interesting specimens to be uncovered and identified, or re-found again. The museum is working hard to curate its collections thoroughly to make this process easier and more accessible.

Bristol Blitz

Bristol received heavy bombing during the Second World War, especially during the Bristol Blitz - a series of air raids from November 1940 to April 1941. On the evening of 24th November 1940, 12,000 bombs were dropped over Bristol almost completely destroying Park Street, including the old museum building (Duncan & Webb, 1999). Also lost were: St Peter's Hospital, the Dutch House, much of the university, Prince's Theatre, 3 Norman churches, 7 newer churches, and 10,000 houses. Alderman Underwood, the Lord Mayor of Bristol at the time, wrote:

"The City of Churches had in one night become the city of ruins."

(Fletcher, 2000)

According to historical notes held by the museum the zoological department was the worst hit by the bombing with many specimens being completely destroyed. The entrance and main hall were also severely hit. Another badly damaged room was the Greville Smith room. This held many of the museum's invertebrate collections, including the Philip Henry Vaughn collection of *c.*50,000 micro Lepidoptera, many of which had been used to add to the British list of 'micros'. Many of these types, as well as the majority of the collections *per se*, were destroyed in the fire that resulted from the bombing, as was the Dame Emily Smyth Botany room. Rhian explains that much of the entomology collection was lost that day and the specimens that did survive no longer had records. One collection that did survive was that of Stephen Barton's tropical beetles, containing many types of several buprestids. Following the war this collection was absorbed into the museum's general collection of world Coleoptera (Fig. 16). Following the blitz many local collectors came forward to donate their own collections to the museum to help to replace those specimens that were lost. One of the first of these was the Charles Bartlett collection which consists of 182 drawers of Coleoptera and Lepidoptera.

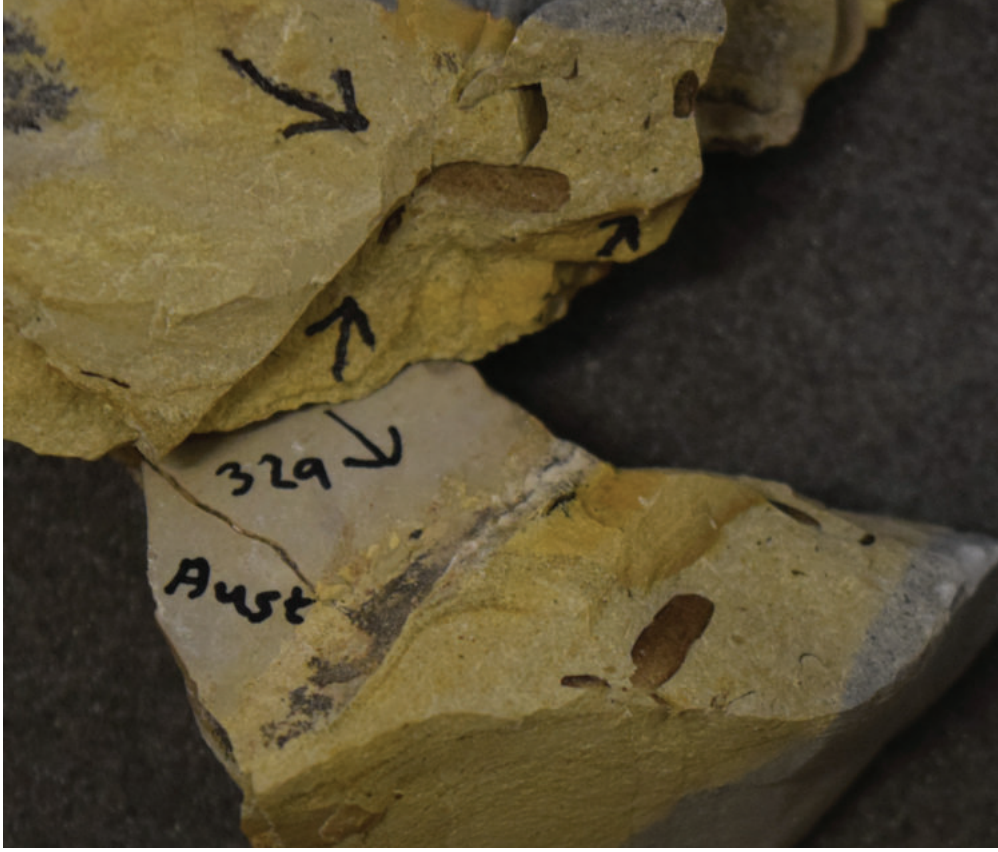

Figure 17: Coleopteran elytra are a commonly preserved part of ancient insects. Here we see both the part and counterpart of a beetle from the Upper Triassic at Aust Cliff, Gloucestershire.

Figure 18: A mecopteran wing from the Jurassic of Britain. Orthophlebiidae: *Orthophlebia liassica*.

Figure 19: An odonatan wing from the Jurassic of Britian that has not yet been identified any further.

Access for academic and amateur researchers:

During our interview Rhian explains the importance of conserving collections for posterity. The importance, she tells me, lies in the fact that as a curator you can never know what the collections will be used for in the future or what ideas researchers will come up with to gather even more data from the specimens. It is not always possible to extract all the possible information from specimens as they are collected due to limitations of time, manpower and money.

Kemp (2015) writes in a recent *Nature* article about the difficulties of working with collections in current times and explains that, as there is still so much information that needs gleaning from specimens, such collections need to be as accessible as possible. He notes that the average lag time between a specimen being deposited in a museum and that specimen being identified is currently 21 years. This is of course highly dependent on resource availability (including scientific interest) and some specimens can be left for much longer without receiving any attention. Many of the specimens I use in my own research were deposited in museums around the country approximately 130 years ago and have received only sporadic attention since. Many are still to be identified and some have found themselves collecting dust, hidden away in boxes and forgotten about.

Bristol Museum is completely open to anyone who wishes to use the collections for research and Rhian explains that they do get some interest. However, she also notes that perhaps the collections aren't as widely known about as they could be and explains the importance of advocating collections to a wide audience. Rhian tells me how they try to build connections with universities, encouraging students to carry out research and advertising the importance of their collections to academics. The problem with this at the moment is the disparity of the collections and Rhian explains that it can take some time to locate all of the necessary specimens of interest to a visiting researcher. However, this is more of a problem for Rhian than for visiting academics and the team will always try their best to locate any specimens needed, and gather as much information on them as possible, before someone visits the museum. I can say

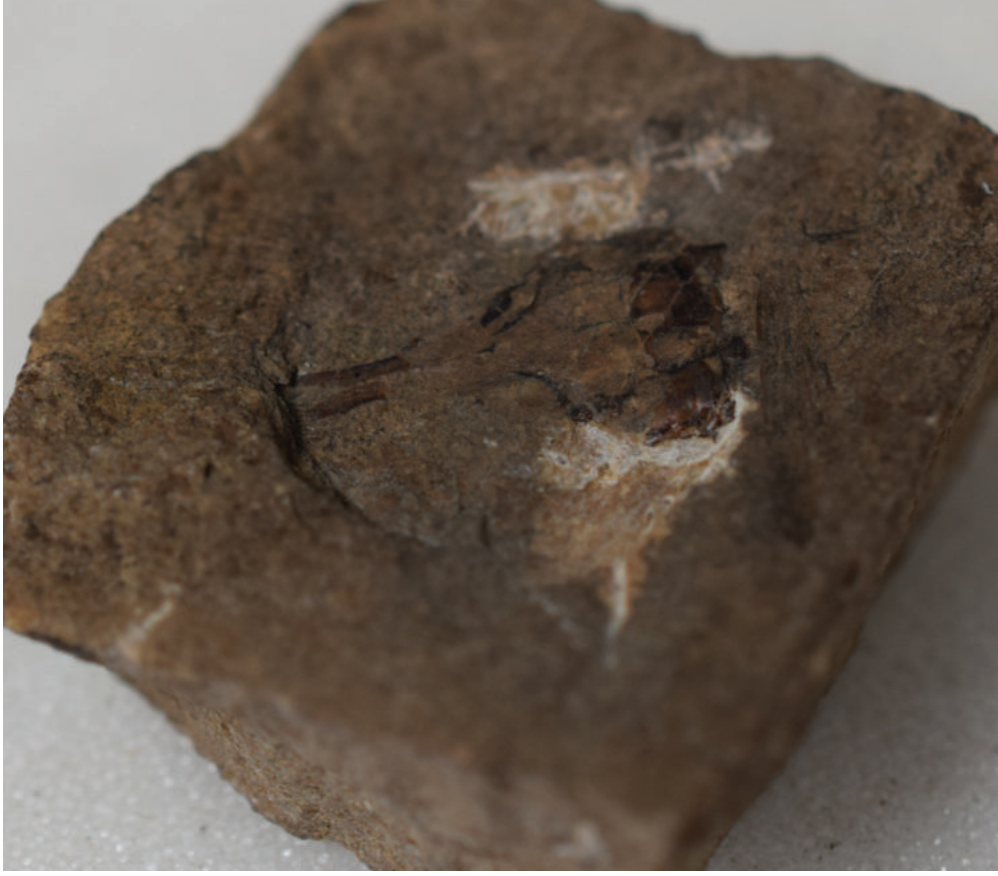

Figure 20: An insect head found in association with fish fossils in the Upper Lias fish beds of Gloucestershire.

Figure 21: An example of the impressions of dragonfly larvae from the Upper Miocene of Switzerland held at Bristol Museum.

from my own experience with the Geology department that this is true. When visiting to work on the fossil insect collections the curator was extremely helpful and had all of the specimens I'd requested out and waiting for me when I arrived!

As well as visiting academics Rhian notes that Bristol is keen to facilitate amateur naturalist groups and individuals. National groups such as the Dipterist's Forum are encouraged to have their AGMs at the museum and to get involved with the collections. Rhian tells me about the wealth of knowledge and experience that exists within naturalist groups and highlights how much she has enjoyed working with them over the years.

Access for public:

Arguably one of the most important roles of a museum is public education and Rhian describes how Bristol Museum encourages the public to utilise the resources the museum offers. As mentioned already, the Diptera project has given rise to several workshops which were originally only offered to interested naturalists. However, Rhian has recently opened up the workshops to the public and describes the reaction as "an explosion of interest". Rhian tells me about people who have visited these workshops simply because they've seen a butterfly in their garden and want to come along so they can identify future insect encounters. Public interest is clearly strong and people are willing to pay to attend a workshop just so they can learn about the insects they observe in their everyday lives. There is a constant demand for more information about insects at Bristol Museum, but Rhian explains that she is often only able to stick with the more popular groups such as butterflies or hoverflies, with the more niche taxa only getting attention from their respective naturalist groups. The long term plan is to develop a catalogue of workshops over the next few years which can be re-run a couple of times per annum. Asides from the workshops, the museum offers bespoke stores tours for the general public and any visiting academics. The tours are geared to the interests of the group and, as all of the stores are in the same place, it is easy to show people many specimens from different groups in a single visit.

Palaeoentomology:

As well as the extensive entomology collections in the Biology department Bristol Museum also holds an impressive collection of fossil insects in its Geology department. There are some notable collections on site, such as that of E.A. Jarzembowski from Aust Cliff in Gloucestershire of mostly Triassic coleopteran elytra (Fig. 17). The M.J. Simms collection is also quite impressive, collected from various sites in Gloucestershire it holds mainly coleopteran elytra, but also examples of Odonata, Neuroptera, Mecoptera and Blattodea.

Though the majority of the specimens are coleopteran elytra, there are also several very interesting wing specimens with preserved venation allowing for more accurate identifications. For example, there are a few specimens of Mecoptera (Fig. 18) that have been identified to species level based on wing venation, and an example of an Odonata wing (Fig. 19) in which certain characters can be used to identify it (such as the apparent pterostigma seen to the left). There is also a rather splendid specimen of an, as yet unidentified, insect head (Fig. 20). Some of the most beautiful specimens I saw in the collections were impressions of dragonfly larvae from the Miocene (up to 23 million years ago) (Fig. 21). Looking down at these specimens one can't help but wonder on the environments they lived in and the interactions they were part of.

In conclusion, Bristol Museum is a resource waiting to be plundered by interested minds, academic and non-academic alike. The natural sciences team is dedicated to advocating their collections for scientific research and is keen to hear from anyone wishing to use these collections in their research. After all, what are these specimens collected for if not to further our understanding of the natural world?

For the next stop on our tour I will be making the relatively short trip to the West Midlands to visit the Birmingham collections, dispersed between Birmingham Museum & Art Gallery, ThinkTank and Birmingham University's Lapworth Museum. If you are a curator of a natural science collection which would be of interest to entomologists then please do get in touch and I will arrange a visit.

Further Reading

www.bristolmuseums.org.uk/bristol-museum-and-art-gallery/

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NIW 2014 Photography Competition winners

In keeping with National Insect Week 2014's overall theme of 'Little Things That Run The World' our Photography Competition offered amateur photographers the opportunity to submit up to three prints in each of two categories: "*Insects Alive!*" and "*Small Is Beautiful*". The Competition was sponsored by the Royal Entomological Society with cash prizes of £500 and £250 for the 1st and 2nd Prize Winners in each of the categories. The category titles (and the prize-money) attracted substantial international interest with a total of 865 entries from 200 photographers in 25 nations, featuring a wide variety of insects from at least 40 different countries, with similar numbers of entries for the two themes.

My colleagues on the judging panel were Sophie Stafford (editor, writer and magazine consultant, formerly Editor of BBC Wildlife magazine) and Alastair Driver (National Conservation Manager of the Environment Agency): I am very grateful to them both for their keen eyes, their reasoned and clear decision-making, and their stamina through the six-hour judging session. In addition, Alastair (for several Odonata) and the following specialists for other taxonomic groups have kindly answered my queries about identification of insects featured in the prize- and award-winning images: Roger Key (for cerambycid beetles); Walter Tschinkel and Glenda Orledge (for ants); Dick Vane-Wright and Michael Boppré (for Lepidoptera); Martin Hall and Nigel Wyatt (for calliphorid flies); and Neal Evenhuis (for bombyliid flies).

The judges were all impressed by the high quality of the submissions in this 2014 Competition. Alastair Driver noted that it was "by far the best standard overall since we started the Competition in 2006, and Sophie Stafford said that "the entries displayed increasing creativity and a range of innovative camera techniques, helping this year's Competition to become the best showcase of insect photography yet." I agree with them entirely and I have also been pleased to see the continued decrease in the number of ineligible photographs of creatures with the 'wrong number of legs' and a considerable increase in diversity of the types of insects represented.

This year, we asked the prize-winning and commended entrants to provide not only a high-resolution copy of their images but also some notes about the taking of the photograph or the behaviour of the insect itself. We plan to add these as optional captions for viewing in the slide-show of all the successful images on the NIW website at www.nationalinsectweek.co.uk, so that this information will support NIW's aim to promote awareness and understanding of insects more generally.

Chris Haines
NIW Adviser

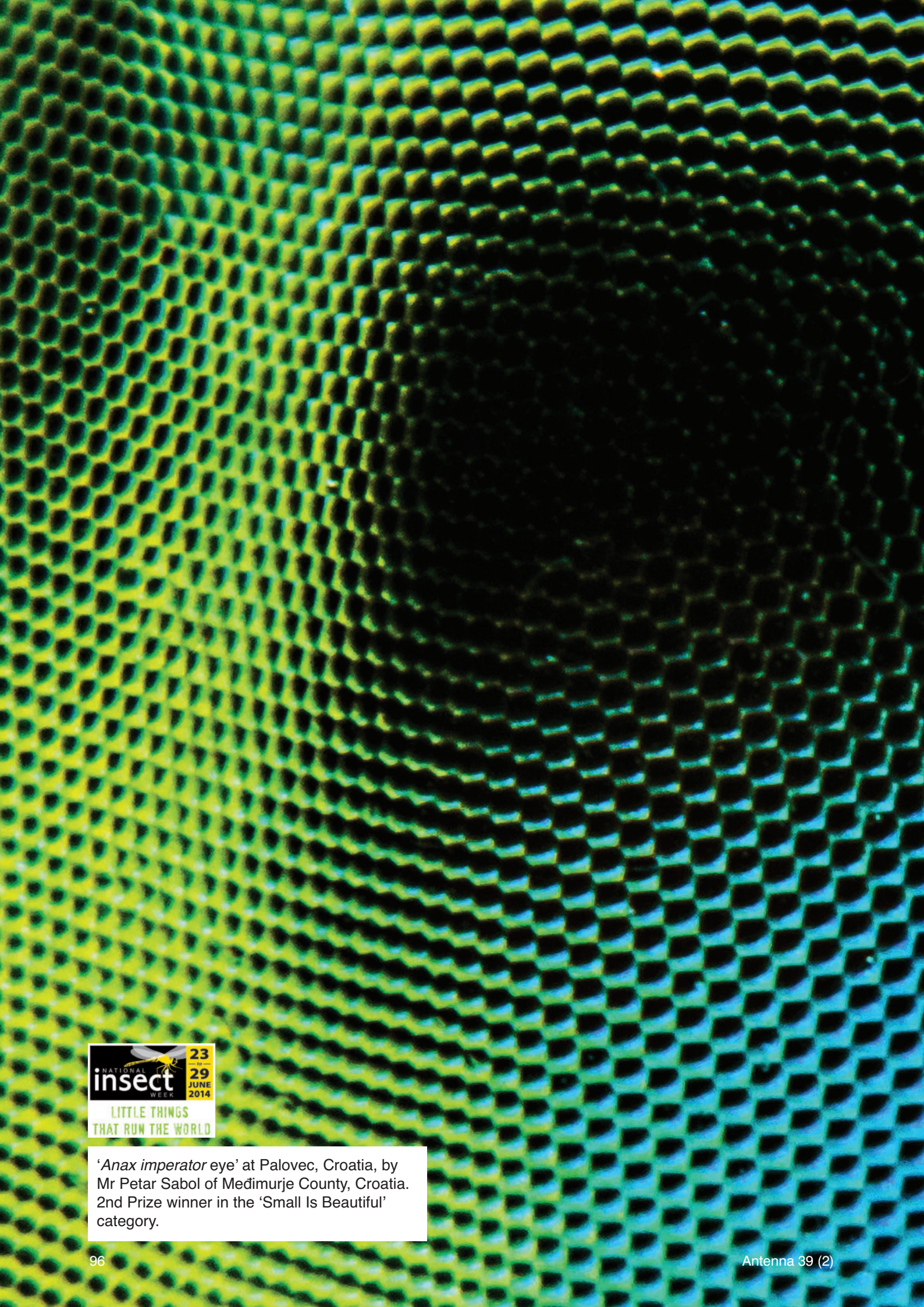
NATIONAL insect WEEK 23 to 29 JUNE 2014

LITTLE THINGS THAT RUN THE WORLD

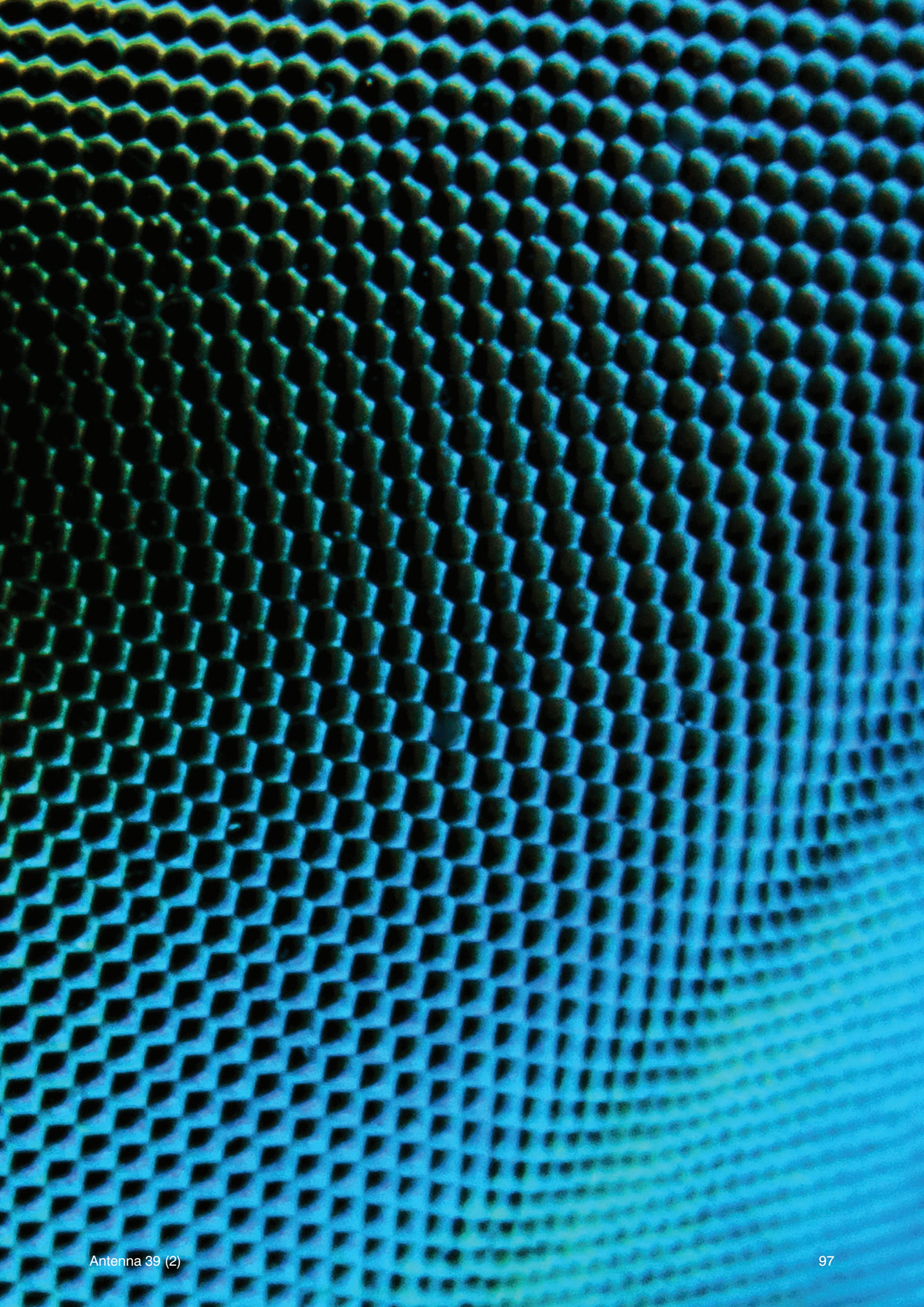
‘Damselflies (*Platycnemis pennipes* and *Coenagrion puella*) mating’ at Palovec, Croatia, by Mr Petar Sabol of Međimurje County, Croatia.
1st Prize winner in the ‘Insects Alive!’ category.

'Wallace's *Cyriopalus* beetle (*Cyriopalus wallacei*)' in Sabah, Malaysian Borneo, Malaysia, by Dr Tim Cockerill of East Yorkshire, England.
1st Prize winner in the 'Small Is Beautiful' category.

‘Sawflies eating a birch leaf’ at Long Clawson, Leicestershire, England, by Dr Anthony Cooper of Leicestershire, England.
2nd Prize winner in the ‘Insects Alive!’ category.



'*Anax imperator* eye' at Palovec, Croatia, by Mr Petar Sabol of Međimurje County, Croatia. 2nd Prize winner in the 'Small Is Beautiful' category.



‘Fire and brimstone!’ at Chalfont St Giles, Buckinghamshire, England, by Mr Keith Pursall of Buckinghamshire, England
Specially Commended in the ‘Insects Alive!’ category.

‘Ready’ at Pavagadh, Gujarat, India, by Mr Narayan Patel of Gujarat, India.
Specially Commended in the ‘Insects Alive!’ category.

‘Manganese drill bit’ in Brno, Czech Republic, by Mr Adam Poledníček of Cornwall, England
Specially Commended in the ‘Insects Alive!’ category.

‘Life in the lily-pads’ in Cleveland, Ohio, USA, by Ms Liz Pearson of Florida, USA.
Specially Commended in the ‘Insects Alive!’ category.

‘Reborn’ at Bogor, West Java, Indonesia, by Mr Beni Arisandi of Jakarta, Indonesia.
Specially Commended in the ‘Insects Alive!’ category.

‘Male feather-horned beetle’ at Carine Swamp, Perth, Australia, by Mrs Kerry-Ann van Eeden of Perth, Australia.
Specially Commended in the ‘Small Is Beautiful’ category.

‘Dromedarius’ at Genemuiden, The Netherlands, by Mrs Beverley Brouwer of Overijssel Province, The Netherlands. Specially Commended in the ‘Small Is Beautiful’ category.

‘Striking a pose’ in Danum Valley, Sabah, Malaysia, by Dr Tim Cockerill of East Yorkshire, England. Specially Commended in the ‘Small Is Beautiful’ category.

National Insect Week

NATIONAL insect WEEK 20 to 26 JUNE 2016

LITTLE THINGS THAT RUN THE WORLD

Luke Tilley

RES Director of Outreach & Development

luke@nationalinsectweek.co.uk

www.nationalinsectweek.co.uk

It is that time between campaigns when we can look back at National Insect Week 2014 and look forward to 2016. National Insect Week 2014 was the sixth biennial campaign organised by the RES and it was supported by 68 official partners – the largest number to date; please visit www.nationalinsectweek.co.uk for more details. The aim of the campaign is to increase public awareness of insects and their importance. National Insect Week (NIW) is one of the major outreach activities of the RES and contributes towards the Society's role to disseminate information about insects and entomology. During NIW, we help the public, of all ages, to discover the fascinating insects that can be found in the British Isles and around the world.

Little things that run the world

The 2014 campaign (23rd-29th June) had the overall theme of 'Little Things That Run The World'. This was taken from E.O Wilson's 1987 paper, 'The Little Things That Run the World (The Importance and Conservation of Invertebrates)' and chosen to draw

attention to the global importance of entomology. The feedback about this theme was overwhelmingly positive and 'Little Things That Run The World' will continue to be the main strapline for National Insect Week 2016 (20th-26th June). It manages to capture the global importance of insects and hint at how vast entomology must be as a science - all in a snappy strapline, thank you Prof Wilson.

Importantly, this theme can also be used to represent any area of entomology and allows the official partners and event organisers to offer events from across all disciplines, showing the public 'Little Things…' from a wide range of taxa, sometimes including other terrestrial invertebrates as well.

Events

A superb total of 403 events were registered on the NIW website (278 in 2010; 306 in 2012). Event organisers were provided with information and merchandise, and offered support from the RES to organise and promote their event. Events were as diverse as the insects on which they focused. Insect hunts, talks, exhibitions, bioblitzes, craft activities, identification workshops and competitions took place nationwide, attended by over 50,000 people. Please contact general@nationalinsectweek.co.uk if you would like to organise an event for 2016.

Partners

As in previous years, the official partners were the main driver of National Insect Week. The number of organisations taking part in 2014 was larger than previous years, which in turn increased the number of events registered, the variety of activities offered, the amount of website activity and the overall impact of the campaign. Each partner organisation contributed to the success of National Insect Week by holding events or providing information for the public. We would like to thank all of the partner organisations and event organisers for their hard work and ideas before, during and beyond the 2014 campaign. If you would like to become an official partner organisation for 2016 please contact me via email (luke@nationalinsectweek.co.uk)

The Launch

The launch event was held at the Natural History Museum, London in the Flett Lecture Theatre and Foyer on Monday 23rd June. Approximately 150 guests attended from partner organisations, schools and the media. The foyer of the Flett Lecture Theatre was filled with insect exhibits, including wonderful artworks from Tessa Farmer and Alberto Congusto and some remarkable exhibits from the Natural History Museum on insect diversity and forensic entomology. The winning entries from previous years' NIW photography competitions were on display. There was also a digital presentation of some stunning images from photojournalist Charlie Hamilton Jones, taken from the BBC series "I Bought a Rainforest".

Thirty schoolchildren from Drayton Park School Highbury took part in the launch event, following a bug hunt in the Museum's wildlife gardens,

Insect Question Time.

Children from Drayton Park School on an insect hunt with entomologists.

Karim from Drayton Park School, Highbury asking the panel a question about insects.

Jonathan Ross with stag beetle.

HRH The Prince of Wales being shown pooters by schoolchildren; inset: Moth hunting at Highgrove House (Theo from St Francis School, Stratford)

accompanied by entomologists and television and radio personality Jonathan Ross OBE.

To mark the official launch of the campaign there were some inspiring introductory speeches by Sir Michael Dixon (NHM Director), Prof John Pickett CBE FRS (RES President) and The Earl of Selborne (RES Vice-Patron). We were then treated to an 'Insect Question Time' – a panel of entomologists answering questions from the public, chaired by Jonathan Ross and streamed live on YouTube. The Insect Question Time was very well received by people of all ages and certainly worth repeating in the future. Special thanks must go to the panellists Max Barclay, Sarah Beynon, Tim Cockerill, Roger Key and Andrew Polaszek, as well to Jonathan Ross for giving up his time to do such an excellent job dishing out the questions and keeping the entomologists in check. The day provided photographic opportunities and a chance for the partners to discuss their events and contributions. It was an excellent start to what became the biggest campaign to date.

A Royal Buzz

Sixty schoolchildren from across the country joined a team of entomologists to take part in an invertebrate bioblitz in the grounds of Highgrove Estate, Gloucestershire – the private residence of TRH The Prince of Wales and The Duchess of Cornwall. The Prince of Wales had previously taken part in a National Insect Week survey at Clarence House in June 2012. The schoolchildren were all winners in the Green Ambassador Awards run by the World Wildlife Fund. A number of the entomologists revisited Highgrove in the weeks after NIW to continue their recording. Hundreds of insect species were, and continue to be, identified from the bioblitz and a report will be presented to HRH The Prince of Wales once all the specimens have been identified. We would like to thank His Royal Highness and the staff at Highgrove for taking part in NIW once again. Particular thanks must go to Andrew Halstead and the team of hard-working entomologists that have put together the species list for the Estate.

Competitions

Two main competitions ran during NIW and beyond:

The National Insect Week Photography Competition

Building on its success in previous years the, NIW Photography Competition continues to be popular. The impressive winning images and further details can be found in this issue. Sincere thanks must go to NIW adviser Prof Chris Haines for organising another successful competition.

David Bellamy OBE and Rebecca Dixon-Whatmough (ASE) with winning entries from The Great Bug Hunt.

The Great Bug Hunt

This was a classroom project asking children to submit a workbook on British invertebrates, run in conjunction with the Association for Science Education (ASE). The entries were judged by David Bellamy OBE and representatives from the AES and RES. First prize was an 'insect day' at the school provided by the RES. Other prizes were kindly provided by Hexbug. The winners were announced during the Week as:

1st Chase Grammar School, Cannock, Staffordshire

2nd Curry Rivel C of E Primary School, Somerset

3rd Westonbirt Prep School, Westonbirt, Gloucestershire

Online

www.nationalinsectweek.co.uk

As in previous years, the NIW website served as a focus for the public and media to find out about the campaign and insects in general. The site lists the events taking place and allows people to navigate to all of the partner organisation websites, their initiatives and activities. The website features images, videos and podcasts. The podcasts were particularly popular and consisted of 12 separate interviews with entomologists about their work. They can still be listened to at www.nationalinsectweek.co.uk/podcasts. Facebook and Twitter content was used to support the campaign by posting and tweeting about insect news, events, resources and competitions. Francisca Sconce and Chris Jeffs should be especially thanked for their hard work online.

Overall, the events and activities organised in 2014 reached more people than any other NIW campaign. National Insect Week 2014 had more official partners, more online activity and more media coverage than ever before. Plans are in place to make 2016 even bigger. Please get in touch if you'd like to be involved.

The RES would like to express sincere thanks to everybody that was involved in 2014, and helped towards increasing public interest in insects and entomology, particularly in young people. There are too many to list here by name but a national campaign would not be possible without hundreds of people using their knowledge and enthusiasm to help the public learn more about The Little

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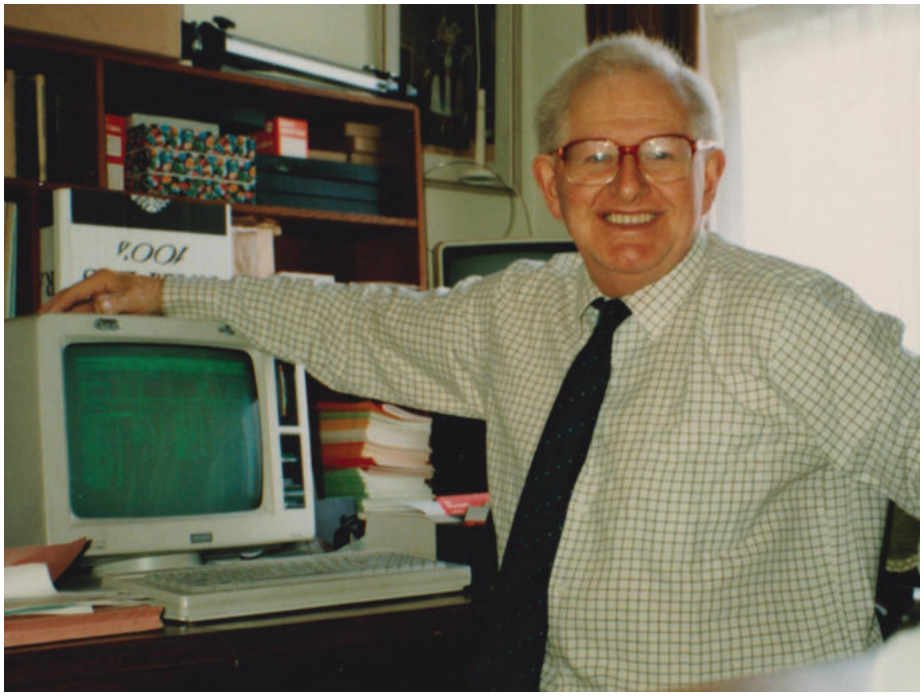
OBITUARY



Dr Brian Oliver Cordery Gardiner
FRES FLS

Brian O. C. Gardiner passed away at Addenbrooke's Hospital in Cambridge on 17 October 2014, aged 91. He was one of the last Entomologists of the old school, a field naturalist, scientist, author and editor; doyen of livestock breeders, leading authority on the Large White butterfly, and consummate bibliophile. He was a stalwart of Entomological and Learned Societies and shared generously of his time and expertise.

Brian was born in Enfield on 10th March 1923 to Oliver, an Engineer, and Anne (née Mitchell). His grandfather was the renowned historian Samuel Rawson Gardiner, leading authority on the Puritan Revolution who traced his descent from Oliver Cromwell.

At the age of one the family moved to Dover, occupying a comfortable house just outside the town near Kearnsey. The garden 'of one and three-quarter acres, well-wooded' was bounded on one side by a railway cutting, where he described "vast numbers of butterflies…so many that he only had to lean over the fence and wait for them to fly into his outstretched butterfly net". His mother's story was that his life as an entomologist started when he was about six or seven. During one of her tea parties little Brian took a dislike to a certain Mrs Blackie, wife of the local bank manager, so he went off into the cabbage patch, collected some caterpillars (*Pieris brassicae*?) and proceeded to put them onto the back of the good lady, much to his mother's horror. "No doubt I was suitably chastised, but if so it did not put me off collecting caterpillars", he wrote. After attending St. George's Kindergarten and Sandgate Prep School, he was sent to Uppingham, from where at 16 he had his first entomological notes published in 1939, the year that he also joined the Amateur Entomologists' Society. During the early years of the war he recounted catching a bilateral gynandromorph Holly Blue under 'occasional desultory artillery fire', the Kearnsey railway tunnel by then housing a rail-mounted gun to fire across the Channel, which attracted return salvos from France. On another occasion he was awoken by a large chunk of German shrapnel that had come through the bedroom roof, landing on his pillow just an inch or two from his head.

After leaving School in 1941 he went to read Medicine St. Bartholomew's Hospital Medical School in London. After gaining a first MB he determined not to pursue a medical career but instead follow his passion for entomology, and jumped at the offer of a temporary post under Norman Riley in the Department of Entomology at the British Museum (Natural History). During this time he had his first experience of editing Journals, becoming assistant editor of the AES Bulletin with Beowulf A. Cooper from 1946 to 1949. The post-war years also saw him elected as a Fellow of the Royal Entomological Society, and travelling (unusually for 1948) to holiday in Tunisia, from where brought back a fine collection of beetles. He secured a job with the Agricultural Research Council under Professor Sir Vincent Wigglesworth and moved to Cambridge, which was to become his permanent home. It was here that he met and married (in 1951) Doris, his wife of 63 years.

The 1950s were a busy and prolific period and he became an enthusiastic collector and recorder, particularly frequenting Monks Wood, Wicken, Holme, Woodwalton and Chippenham Fens, regularly turning up new species even at these well-known localities and becoming something of an authority on the Lepidoptera of Cambridgeshire,

publishing widely on the subject. He was often accompanied on moth trapping or field excursions by well-known entomological names including Claude Rivers, Teddy Pelham-Clinton, John Heath or Eric Classey.

Due to his familiarity with the fenland fauna and a growing reputation as a livestock breeder, it was natural that in 1954 the National Trust should ask him to assist in rearing sufficient swallowtails, sourced from the Norfolk Broads, for a re-introduction programme to Wicken Fen. Over a period of eight years he was able to provide many hundreds of butterflies for release and although the project was ultimately unsuccessful, this was linked to the unsuitability of the habitat rather than a shortage of supply.

At the same time he was beginning his long-standing association with the Large White *Pieris brassicae*, used in his professional life as a laboratory culture insect. He became the first person to successfully break diapause in this species and so commenced a continuously brooded culture that he was able to sustain with up to eight generations per year for over 30 years, until after his retirement. With his colleague W.A.L. David he published numerous papers on the species, many focusing on its interactions with granulosis virus. The long-running year-round breeding programme of *P. brassicae* threw up problems in continuously supplying them with fresh food, and also of maintaining a sufficiently consistent subject for research needs, and free from the pathogens liable to be introduced with live foodplants. These difficulties were addressed during the 1960s as Brian helped pioneer the use of completely artificial diets for rearing Lepidoptera, successfully demonstrating their use first with *P. brassicae* and subsequently with a range of other species including *Acherontia atropos* and C*acoecimorpha pronubana* (Tortricidae). This work led to a collaboration with Philip Harris Biological Ltd. who marketed the 'Harris Pieris culture kit', combining live *P.brassicae* eggs that he supplied, with a supply of frozen artificial diet to allow schools and colleges to conduct their own rearing experiments, and for which he also wrote the accompanying booklet. A further innovation was the use of 'artificial flowers' (painted Perspex discs with a central tube filled with sugar solution) that allowed adult butterflies to feed year-round without the troublesome and expensive necessity of sourcing sufficient nectar-rich flowers. Such was his success with this species that he was able to provide the 30,000 larvae required for an examination, in the space of just 3 weeks. Never one to rest on his laurels, he set up his own entomological enterprise, Cambridge Biotech Supplies, adding locusts and cockroaches to his breeder's stable – housed in a purpose-built garden shed. All of the major entomological suppliers engaged his services as a reliable source of livestock, including Michael Dickens at Newman's Bexleyheath butterfly farm and Robert Goodden at Worldwide Butterflies, who became a life-long friend.

A further development in his association with *P. brassicae* was the chance occurrence, within the laboratory culture, of new aberrations. Most notable amongst these were the exquisite blue-winged form ab. *coerulea*, the yellow-winged ab. *jauni*, and an albino variety, ab. *albinensis*. By selectively breeding these he was able to determine the genetic origin of each form, and to produce unique and remarkable crosses such as *coerulea/albinensis* (1963). Colleagues and contacts from the world over would periodically supply him with new races of *P.brassicae* including the boldly marked *cheiranthi* from the Canary Islands, which provided further striking hybrids. The addition of food dyes to the diet medium prompted the emergence of garishly coloured 'whites'; on more than one occasion he spotted traders attempting to pass off these curiosities as genuine aberrations. The 'Cambridge Stock' as it was known also spawned a good number of gynandrous and homeotic specimens and he built up an unrivalled collection of this species.

Perhaps the most extraordinary moment arising from his work with *P. brassicae* was the time he found himself on stage with Mick Jagger during a Rolling Stones concert. The occasion was the memorial concert for Brian Jones in Hyde Park in 1969, when as a tribute to the late guitarist, 3000 white butterflies were to be released. Who else would be asked to supply such a large number of adult butterflies to be ready on a particular day (boxes of chilled butterflies were stowed in the garage to ensure their survival until their big day), and he can be seen in footage of the event, standing stage left, wafting the insects from their containers.

Shortly after this he transferred from The ARC Field Station in Cambridge to their Unit of Invertebrate Chemistry and Physiology based in the Department of Zoology under Dr. John Treherne. Here he began his long collaboration with Dr. (now Professor) Simon Maddrell. The work here was focused on another insect, the blood-sucking Hemipteran *Rhodnius prolixus*. Their research covered complex chemistry of respiration in this species which is a vector in South America for the deadly Chagas disease (trypanosomiasis). He became adept at rearing these insects, which this time offered quite different challenges, requiring blood from a live host, which in this case was supplied by Dutch Giant rabbits and sheep. (Gardiner & Maddrell 1972). He was not squeamish about demonstrating how innocuous this procedure was by applying the bugs in their gauze-sided capsules to his own skin, and offering the same opportunity to visitors, usually to their horror.

Though busy at work and home, and by now having four children, in his spare time he was immersed in the Entomological world. He served the Amateur Entomologist's Society with great distinction, Editing their Bulletin from 1974-1994 during which period it increased in size by a hundred pages per volume and in frequency from quarterly to bi-monthly, while colour plates became a regular feature. He was appointed President of the Society 1977/8 and became an honorary Life Member in 1982.

His skills as an editor were also utilised by *The Journal of Research on the Lepidoptera* for whom he was Associate Editor for 15 years; and The Royal Entomological Society, editing *The Entomologist* from 1989-1997. He became a Fellow of The Linnaean Society in 1976. He retained a great interest in rearing insects of all kinds and had successfully bred a number of silkmoths which others had found difficult. The culmination of this work was the publication, in 1982, of *A Silkmoth Rearer's Handbook*, which he edited and substantially revised, becoming the standard work on this subject for many years.

Parallel to his interest in entomology was a great love of antiquarian books on the subject, building a fine collection and becoming an

acknowledged authority. From his first published remarks on books (entitled '*Drury & curiouser*') in 1949, he maintained a scholarly interest in authors, printing methods, or the intricacies of identifying early editions, and kept a keen eye on auction prices, attending many of the great entomological sales. He had a compendious knowledge of early natural history publishing and took a delight in retirement in tracking down and collecting books that had escaped the attention of Freeman (1980) in his handlist. He took up bookbinding and greatly enjoyed restoring and re-binding bargains that came his way from bookshop or auction; he also bound, in matching livery, his extensive collection of journals. In later years he took readily to computing and the internet, selling many of his books on ebay, whilst acquiring almost as many. He was a frequent visitor to the bookshops of Cambridge, travelling on his trusty 1948 Humber cycle (with its original saddle!) well into his 70s.

Whether at work in the department of zoology, as editor, or in the realm of books, none of the many who came to him for help or advice were turned away. He gave generously of his time and expertise and was always keen to encourage the next generation of entomologists. The AES named the Gardiner Award in his honour, to reward the best contribution to their Junior Bug Club Magazine. Many a novice was grateful for his sage advice; equally, experienced entomologists came to his door, one such being the Hon. Miriam Rothschild looking for help with her work on plant toxins in insects, a collaboration that led to several published papers.

Though he suffered ill health in later life having suffered several heart attacks, he retained a cheerful disposition and remained a lively correspondent and active member of numerous organisations. In addition to his long association with the Royal Entomological and Amateur Entomologists Societies he supported The Wildlife Trust, Society for the History of Natural History, Cambridge Natural History Society (their Annual *Conversazione* was one of the highlights of his year), and the British Entomological and Natural History Society.

He is survived by his four children and widow Doris, who supported his endeavours throughout their long marriage. There was a poignant moment at his memorial service. While the mourners (who, at the family's request, sported ties or brooches with a butterfly motif) gathered, a peacock butterfly descended from the nave and alighted briefly on a pew before climbing again towards the stained glass windows; a fitting farewell gesture to a remarkable entomologist and a true gentleman.

Chris Gardiner

OBITUARY

Dr John Malcolm Cherrett

1935 - 2014

John Malcolm Cherrett was born in Bishop Auckland, County Durham where his family had a printing business. He was educated at Durham School and St John's College, Durham University where he read Zoology. After graduating in 1957 he subsequently went on to complete his PhD on moorland spiders under Professor James Cragg. Malcolm then opted to study for a PGCE in London University where he achieved distinctions in both educational theory and practice. In 1961 he was appointed Assistant Lecturer in Applied Zoology at the then University College of North Wales at Bangor (now Bangor University), where in 1986 he achieved a Readership in the School of Biological Sciences.

A University College Bangor expedition to Guiana in 1963 triggered Malcolm Cherrett's early research was on the ecology and behaviour of moorland spiders, but his subsequent entomological studies were concentrated on leaf cutting ants of the genera *Atta* and *Acromyrmex*. In addition, he investigated plant-animal interactions using rhizotrons as the underground observational tool and studied the impact of grazing on invertebrate production.

University College of North Wales Bangor Expedition to Guiana 1963; Malcolm is in the centre of the back row (courtesy of Jane Cherrett)

what was to become a life-long interest in tropical ecology with more than 20 working visits, mostly to Trinidad, where he held a British Ministry of Overseas Development Senior Research Fellowship from 1966 to 68. Later he worked in a further nine countries including Guyana, Brazil, Paraguay, Peru, and Mexico. At Bangor he established and headed a Leaf-cutting Ant Control Unit, the first in Europe, and was instrumental in bringing the first live leaf-cutting ants into the UK under licence. During the 1970s Malcolm was a British Technical Assistance Expert to the Governments of Paraguay and the Seychelles.

His research focussed on the interactions of the ants with other organisms, particularly wild and cultivated plants, and he brought to it his characteristically thorough field work, patience and insight. The way in which the ants cultured their fungus and the benefits of mutualism to both were studied along with the role of leaf-cutting ants in tropical rain forest regeneration. He concluded that much (95%) of the ants' energy requirements derived from plant sap, not the fungi which they cultivated. The ants sampled several species of plants, but cut a large amount of leaf material from only a few species during a foraging period. However, even the most highly preferred were usually abandoned before being completely defoliated. Malcolm also proposed the hypothesis that the protein deficiency (or Southwood's 'nutritional hurdle') faced by such herbivores was overcome in leaf cutting ants by utilising fungi for their growing larvae. This formed the basis for considerable research under field and laboratory conditions to understand what determined the ants' choice and what effect these preferences had on the plants involved. Malcolm's extensive collection of reprints on leaf cutting ants are deposited in the RES library at The Mansion House, Chiswell Green.

Using root observation chambers (designed and constructed at Bangor University's Botanic garden) Malcolm and his students investigated herbivores feeding on living roots in pastures using radiotracers, and the effects of cutting regimes, fertilizers and pesticides on soil animal-plant root interactions.

Alongside his research and supervision of many research students Malcolm had a substantial teaching role at Bangor, mainly in pest ecology, economics and population dynamics, entomology and human ecology. Externally, he held three-year external examiner appointments in nine UK Universities. His involvement in the undergraduate programme led to him helping to found and run a highly regarded Masters degree in ecology funded by NERC. From 1988-96 he organised the Erasmus and Tempus science student exchange system on behalf of Bangor. This involved many European contacts and meetings in universities, with both their personnel and numerous students. He also served on the NERC Grants & Training Awards Committee in Terrestrial Life Sciences and was a member of the AFRC Institute of Arable Crops Research Visiting Group.

He undoubtedly played a crucial role in the British Ecological Society serving on its Council from 1974-78 and as Council Secretary for eight years (1977-1985) during which the Society grew from 3580 members to >4000. His survey of the ecological ideas and findings which had, in the opinions of the members, made the most impact on science and world affairs was published to celebrate its 75 year jubilee (Ecological Concepts 1989). Malcolm was a founder member of the British Arachnological Society, a Fellow of the Royal Entomological Society and active in the Forest Entomology Group. He was a member of the International Union for the Study of Social Insects, a member of the Association of Applied Biologists and served on the editorial board of several journals including *Ecological Entomology*, *Agriculture, Ecosystems & Environment* and *Protection Ecology*.

Malcolm was often to be seen on field trips carrying his trademark umbrella and wearing his customary bow tie which was his everyday dress. He was a charming man with a gentle sense of humour (a leaf-cutter ant induced by him to climb a ramp for a camera was seen to be carrying a banner on its back promoting "home rule for Cumberland.") and a perfect gentleman. Travelling to Bristol to participate in a BBC Natural History Unit programme with Johnny Morris he steadfastly took leaf cutting ants with him. They were contained in vials in a special corset made by his wife, which was secured around his chest so that the insects were maintained at the correct temperature on the journey. He confessed later to have been on edge for much of the journey in case they escaped!

Malcolm Cherrett died on 29 August 2014 and is survived by his wife Jane, also a Durham Biology graduate, and their son Tom to whom we accord our deepest sympathy at their loss.

Dr William Block
Emeritus Fellow,
British Antarctic Survey

Society News

Council Matters December 2014

The December Council was chaired by the President, Prof. John Pickett. The President led a discussion on the issue of 'Open Access' and how it might affect the Society. He explained that he had been in contact with the Royal Society of Chemistry and other learned bodies to gauge how they were responding to this development in academic publishing.

The Registrar gave an overview of the current situation with regard to updating the Society's Bye-Laws. He had held meetings with Mr Willans, the Society's solicitor and Mr Lawrey, a barrister connected to the Foundation for Science and Technology. Mr Lawrey advised the Society to apply for an Order in Council, which if granted would allow the Society to make changes to the Bye-Laws without further applications to the Privy Council.

Council were delighted to receive a very pleasant acceptance letter from Prof. Hildebrand, who has been awarded the Wigglesworth Award 2016.

Prof. Hardie, the Society's representative on the Council of the International Congress of Entomology (ICE), gave a written report and presentation outlining the feasibility of hosting the ICE in London in 2020. Although supportive in principle, the President and Council expressed concern about any financial liability and asked for more details of costs and financial arrangements.

Prof. Hardie spoke in his role as Director of Science. He explained the many varied duties involved in putting forward a scientific face to the public and media. Dr Tilley, as Director of Outreach and Development, gave an overview of the considerable number of outreach events that he coordinated, from very local talks to a bioblitz at Highgrove House (the private residence of HRH The Prince of Wales and The Duchess of Cornwall). Council expressed much thanks to Prof. Hardie and Dr Tilley for all their considerable endeavours in promoting the Society.

Dr Murchie, the Honorary Secretary, presented a report on the work of the Meetings Committee. The Committee recommended approval of four new Special Interest Groups (SIGs) on the topics of 'forest insects', 'arthropod cuticle', 'edible insects' and 'public understanding of entomology'. He mentioned that the Aphid SIG will be held in conjunction with our French colleagues in Paris in November 2015. The Wigglesworth lecture is scheduled to be delivered at the ICE 2016 in Florida. It is intended to take the Obligation Book to the ICE, to enable our American (and other overseas) Fellows to take the Obligation and sign. Lastly, Dr Murchie drew Council's attention to the retirement of Dr Les Allen-Williams from the position of SIG coordinator. Dr Allen-Williams had been fundamental to setting up and maintaining the SIG system that has proved so fruitful for the Society's meetings. Council expressed their wholehearted thanks to Dr Allen-Williams.

The Honorary Treasurer gave a brief report on behalf of the Finance Committee. Cash flow in the financial year was positive to the extent of £249K to date (Dec). Ento'15 expenditure projections had been agreed. As had house improvements, in particular the enclosure of the rear porch area.

Dr Clements spoke on behalf of the Library Committee. He paid due credit to the work of the librarian Mrs Val McAtear, who has been proactive in developing and promoting the library, as evidenced by her recent article in *Antenna* 38(3) and the high level of satisfaction expressed in the Membership survey. He also thanked Dr Glenda Orledge, who was stepping down from the Committee, for her considerable and diligent work, and Dr Tony Drain who has undertaken some refurbishment of older volumes for no charge. In addition, Dr Clements thanked Council for approving the enclosure of the rear porch, to provide more storage space for the library.

Council was asked to consider the formation of a new 'Outreach and Development Committee'. The aim of which was to focus on activities beyond the current Membership and with a remit to engage with the public and to attract new Members and Fellows from overseas, perhaps utilising more fully internet and social media communication. Council debated the merits of the new Committee and in particular how it would interact with the existing Membership Committee. Whilst it was acknowledged that there would be overlap, it was felt that there was a very large range of activities that needed to be addressed by the Society as the 21st Century advanced, and that both Committees were required. Consequently, the new Committee was approved, to be chaired by the Director of Outreach.

House of Lords Breakfast Briefing on 'Genetically modified insects and disease control'

Prof. Pickett, as President of the Society, and Dr Murchie, as Honorary Secretary, attended a working breakfast for MPs and Peers in the House of Lords, organised by the Parliamentary Office of Science and Technology and the Society for General Microbiology. Prof. Pickett was among a group of experts invited to address the Peers and he spoke about the importance of insects and applied entomology. He gave an impassioned plea for the need for sensible debate about pest management, the commercial difficulties in developing new control measures (including the staggering costs of registration), and therefore the requirement for Government intervention in R&D. Prof. Pickett then fielded questions from the Lords May and Patel, and Viscount Ridley, amongst others. The Society also lent our support to an evening event at Charles Darwin House on the same topic, which was open to the public.

Honorary Secretary

2014 Ant Course

By Adam John Mears Devenish

The California Academy of Sciences Ant Course has been in existence for the last 14 years and is undoubtedly the place to be if you are fortunate enough to find your research/work involving Formiciidae. Last year, whilst in the depth of writing my literature review for my PhD, I came to the worrying conclusion that I just did not know enough about ants and I began to be filled with dread at the mere thought of keying out 100s of ant species from my impending fieldwork to South Africa and Spain. Up until this point my academic path had focused on plants and as such I had very seldom delved outside my botanical comfort zone. Nonetheless, I had the good fortune to stumble upon the up-and-coming 2014 Ant Course set in the Maliau Basin, Borneo. Without a second thought I began to enquire about the course and pestered Dr Brian Fisher for further information. Shortly after sending off my application I was accepted onto the course and, with some financial help from the Royal Entomological Society, had booked my ticket to Malaysia.

The ant course is billed as a workshop designed primarily for systematists, ecologists, behaviourists, conservation biologists, and other biologists whose research responsibilities require a greater understanding of ant taxonomy and field research techniques. But as I found out it was a whole bunch more, as that year the course coincided with the end of the Quadrennial International Union for the Study of Social Insects Conference in Cairns. As a result the attendees to the ant course (lecturers and students) were literally from nearly every corner of the globe and spanning practically every aspect of myrmecology.

We all arrived in Kota Kinabalu, the capital of the State of Sabah (East Malaysia), for a brief over-night stay before a 7-hour mini-van/4x4 truck journey to our accommodation in the Maliau Basin. Upon arrival, I must admit I had begun to wonder if my innate ability to attract mosquitos was a risky trait in such an environment. But before long, and without much time to think, we were being shown our base of operations: a small lab in the middle of the jungle, which was oddly enough paid for by IKEA! We all soon became familiar with this small but ever so well equipped room, as over the next 10 days we were taught a wide range of subjects from myrmecology, to the evolution of ants. This veritable mountain of information was at times a bit daunting, but it was hard not to be inspired by all the lecturers' knowledge and passion for this field of research. Time not spent in this room was divided equally between a social hour, in which we were all rounded up and pushed out of the door to enjoy the amazing surrounding jungle, or time spent attending evening seminars. The combination of alcohol

From top to bottom: *Polyrhachis*, Steve Shattuck, Maliau Basin, Sabah; Termites, Steve Shattuck, Maliau Basin, Sabah; *Aenictus* trail, Adam Devenish 2014.

Maliau Basin, Adam Devenish 2014

Ant lab, Corrie Moreau 2014

Ant lab, Roberto Keller 2014

and a pleasantly cooled room had the effect of inducing a desire to sleep at times, but notwithstanding this the day never ended early. Many of us worked late into the night keying out ant specimens, until we were forced to stop due to the power being cut off at midnight. I had not expected to find a vast range of ant species during the trip, but a single Winkler sampling revealed a few days worth of work. It was during this time that it all became painfully clear to me that whilst I am now a myrmecologist at heart, the painstaking pinning and mounting of specimens was just not for me. Nonetheless my curio box of precariously balancing ants managed to survive the 6ft drop test and at the end of the day it was not the pinning process, but the joy of keying out specimens that drew me back to that little brightly lit room in the middle of the jungle every night. A beacon of light that soon attracted not only us, but also nearly every insect for miles around. As a result one had to contend with not only the high humidity playing havoc with the pinning process, but the distraction of a veritable horde of visiting insects crawling up you whilst you worked.

Whilst this might not sound like everyone's cup of tea, for us, alas, this once in a lifetime experience was over all too quickly. My only regret about the course is that the myrmecological community did not need to wander very far to find ant specimens; due to this we seldom ventured too deep into the surrounding jungle. In fact, some individuals preferred to stay in the same spot for hours, in order to wait for the ants to come to them. This might have been a wise decision considering the only thing that I found surpassed the ants in number, were the ferocious terrestrial leeches that waited hungrily for you at every step. If this sounds less than appealing to you, do not despair as the next ant course in June this year is programmed to occur in the United States. I can only hope that one day I will be able to attend this course again, perhaps as an invited lecturer…

The Verrall Lecture 2015

The 2015 Verrall Lecture was delivered by Prof Sue Hartley from the University of York. Dr Chris Lyal welcomed the audience on behalf of the Natural History Museum and the Royal Entomological Society and gave a warm overview of Sue's achievements, including her current position as Director of the York Environmental Sustainability Institute (YESI).

Sue's lecture was on '*Sustainable Crop Protection using Natural Plant Products*' and she explained that she had once been introduced rather cheekily as "an expert on silicon but not in a Pamela Anderson way". Global agriculture is facing many problems: climate change, water shortages and stagnating yields. Into this mix, pests and diseases remain recurrent problems. Pests are becoming insecticide resistant and pesticides are being withdrawn from markets following more stringent legislation. We also have a dangerous reliance on a few crops; for example, half of the world's population relies on a single variety of rice, which has 10,000 fewer genes than its wild ancestor. Many of these genes may code for useful traits such as resistance to drought or insect herbivores: modern crop varieties contain far fewer toxins (secondary plant metabolites). This of course means that we can eat them but so can pests. Essentially, we have disarmed our crops through domestication.

Most of our key crops are grasses and they have a secret defence - silicon. This is deposited as solid granules known as phytoliths, which are sharp and abrasive so can act as mini razor blades. Consequently, silicon deters feeding by leaf chewers (foliovores), though sap feeders such as aphids seem less affected. Sue displayed SEM images showing mandibles worn down by feeding on silica rich leaves. Silicon deters feeding and reduces nitrogen absorption due to abrasion. Silicon is an inducible defence and is stimulated by repeated damage with actual herbivore feeding; mechanical damage has less effect on silicon than herbivory. Relatively little is known about how plants uptake silicon, but different plant species deposit it in different ways, for example as spines or nodules, and the manner of deposition has implications for defence against herbivores. To enhance crop protection, could plants be engineered to uptake more silicon? Work comparing locally-adapted landrace varieties of barley (Orkney Bere) with their modern counterparts showed that both varieties have silicon defences, but in crops where they have been lost or reduced, it might be possible to breed commercial varieties with improved silicon uptake.

The concluding part of Sue's talk concerned root-feeding pests. The problem with root feeders, she said, is that once the damage is seen in the plant, it is too late, the roots have been eaten. Plants can be viewed as mediators of interactions between above- and below-ground herbivores. For example, root nematode infection can increase aphid infestation. This may be because the nematodes stimulate the salicylic acid defence pathway, but this does not seem to be effective against the aphids and many compounds which deter herbivore feeding are reduced in nematode infected plants. So in devoting resources to defend against one pest the plant has made itself more vulnerable to another. Controlling root-feeding pests is difficult and many methods have been tried. In the 15th Century, the Bishop of Lausanne even tried to control chafers by ex-communicating them! Sue though spoke about another, hopefully more effective, method. Brassicas are loaded with glucosinolates that when damaged give rise to volatile compounds called isothiocyanates, which have pest control properties. By ploughing brassicas into the soil, farmers can fumigate the soil with isothiocyantes, thus providing an agronomic method of root pest control, just one way the natural defences of plants can help us fight pests more sustainably in future.

Prof. John Pickett, President of the RES, thanked Sue for a humorous and informative lecture. After chairing some questions from the audience, John presented Sue with a memento of her lecture and looked forward to continuing discussion at the Verrall Supper.

Archie Murchie, Honorary Secretary

Left: The Verrall lecturer, Prof. Sue Hartley, with the RES President, Prof. John Pickett; Right: Prof Hartley with Dr Chris Lyal of the Natural History Museum.

Technology and Computing Special Interest Group

Royal Botanic Gardens, Kew, 19th March 2015

Mark A. O'Neill,
Tumbling Dice Ltd

The Royal Botanic Gardens Kew proved to the perfect venue for the 2015 Technology and Computing Special Interest Group. After listening to a set of inspiring talks, delegates were able to explore the historic gardens before reconvening for the afternoon poster and demonstration session. I thought as this is the Technology and Computing SIG, it ought to be advertising itself via social media in addition to the more traditional manner via the RES web site. The effect of applying a "Social Physics" approach like this was telling. The meeting was attended by more than 40 delegates. Moreover, many disciplines were represented in addition to insect science. Attendees included computer scientists, electronics engineers, ecologists and digital mapping experts. In fact a whole host of disciplines interested in either applying technology to insect science, or conversely taking ideas from biology in general (and insect science in particular) were represented.

My principal aim in organising this meeting was to show that the physical and biological sciences are not disconnected disciplines with nothing to say to one-another. In fact, they can learn from each other, and as I believe this meeting has shown, there is a potential for a rich bi-directional flow of ideas across the interface of these disciplines. As Alex Pentland, Ray Kurzweil and others have recently shown, this uninhibited flow of ideas underpins creative growth in all areas of human activity. We are a social animal and by looking at what others do, and modifying it for our own purposes, we move forwards. Furthermore, as the sociologist Mark Granovetter has indicated, inspiration and hence creativity tends to occur when you interact with others outside your immediate work and social groups. I believe that this sort of positive interaction was achieved in no small measure at this meeting. To my knowledge at least two research groups, who were ignorant of each other's work prior to the meeting, are now making plans to work together directly as a consequence of the meeting. Such is the power of Granovetter's "weak ties".

The delegates.

The border between the physical sciences and biology is a long one. Areas of potential crossover include modelling of biological processes, biologically inspired optimisation, tracking and biologically inspired robotics – the list goes on. Perhaps this should not be too surprising, as from the viewpoint of a "Renaissance Man" this border is essentially an artefact of human organisation. After all, physics is simply the mathematics of reality, chemistry the physics of electrons, and biology the chemistry of macromolecules – but as time and human attention span are both limited, I decided to address two themes of direct and practical utility in this meeting:

How insect science in particular (and the biological sciences in general) can inform technology, particularly in the field of robotics.

The rise of "e-ecology" - that is the use of increasingly small and sophisticated sensor modalities to record individual interactions within ecosystems (collecting "big data" for insects).

The first theme was ably presented by two researchers from Richard Bomphrey's insect flight research group, which is based at The Royal Veterinary College (RVC) that located near Brookmans Park in Hertfordshire. Richard and I go back a long way, all the way back to the sleepy market town of Grantham in Lincolnshire in fact: it is a real pleasure to find that I am not the only one to have managed to escape the strictures of the self-styled "most boring town in England".

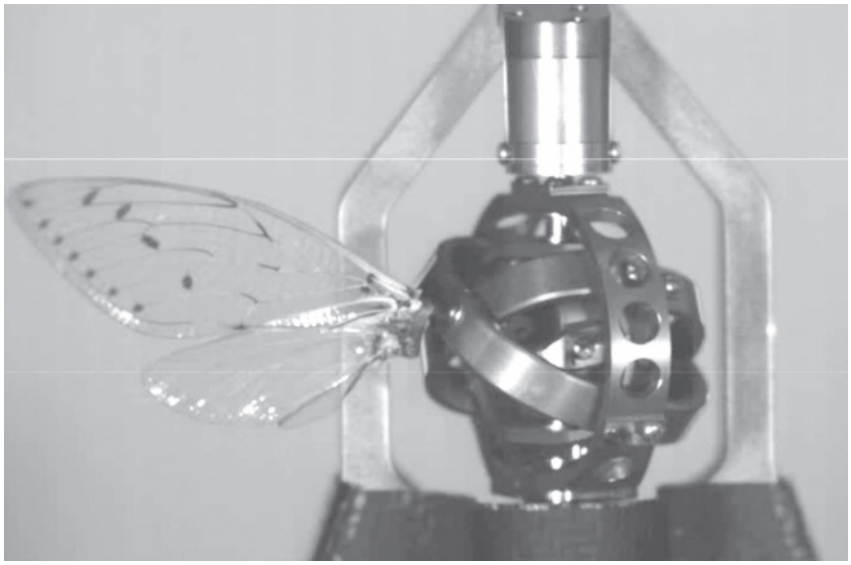
The meeting opened with a presentation by Toshi Nakata (Royal Veterinary College) who spoke about work he is doing;

investigating flight behaviour in vinegar fruit flies (*Drosophila* sp.: Diptera). The presentation was a master-class in non steady state aerodynamics. We learned how it is possible to categorise fruit fly behaviour when in flight by simply looking at emergent patterns within the flight kinematic data. Furthermore we gained some insight into the enormity of the undertaking. Data is acquired using particle image velocimetry (PIV) and then processed using hours of supercomputer time in order to establish the all important behaviour-related patterns. With my electronics and computing hat on, I found myself wondering whether PIV could be supplanted using other methods, for example direct measurement of forces using surface mount accelerometer technology? Questioning Toshi after his talk, it became apparent that this approach might have some mileage in it. It seems even SIG conveners are not immune to the effects of Social Physics.

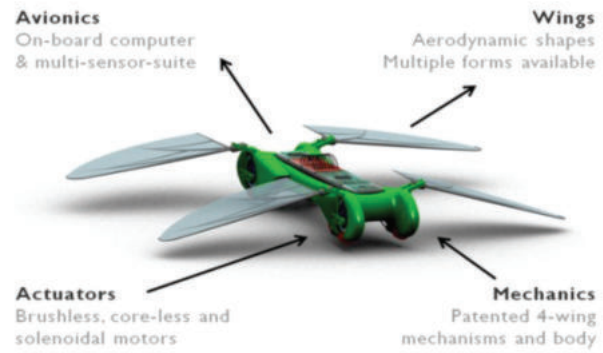
The next presentation was given by Toshi's colleague Nathan Phillips (Royal Veterinary College). Nathan gave an inspiring presentation which showed how we can apply the non-steady state lift mechanisms employed by insects to the upcoming generation of micro-UAVs (Unmanned Aerial Vehicles). In addition, he introduced us to a unique piece of robotics, the "flapperatus". This is a 3 degree of freedom system which can be used to drive insect wings (and indeed arbitrary non-steady state aero structures), in a repeatable manner in order to acquire wind-tunnel data efficiently and repeatedly. When used in conjunction with PIV, we found out that this approach is generating a wealth of data, both supporting the type of study described by Toshi, and also providing kinematic datasets which are invaluable when designing micro-UAV's. But it is not only insect flight which is inspiring the next generation of robots. Other roboticists have also been inspired by the arthropod body plan. Just before this meeting I was lucky enough to tour NASA's Johnson Space Centre ("Houston" to you and I) and in the bowels of building 39, I saw this robot. No doubt, technology inspired by insects will be crawling about on Mars and quite possibly Europa in the not too distant future.

After Toshi and Nathan's presentations about insect inspired robotics, we had a change of theme. The next two speakers, Richard Gill (Imperial College) and Sarah Barlow (Royal Botanic Garden, Kew), concerned themselves with "e-ecology". In particular, how we can redeploy commercial off the shelf (COTS) technology, originally developed for the mobile phone and other consumer electronics markets, to efficiently gather large ecological datasets.

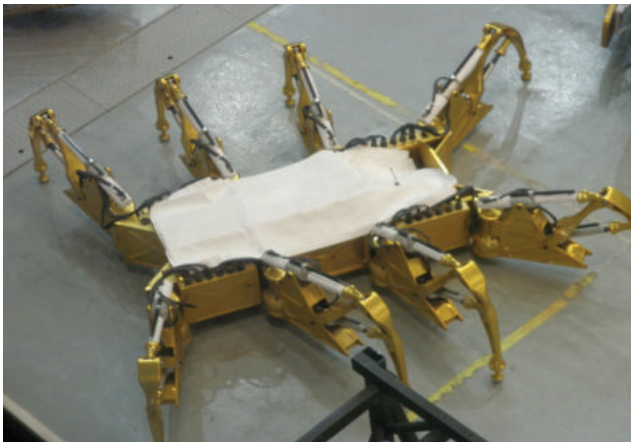
Richard gave an interesting and informative presentation on how he has been using short range COTS Radio Frequency Identification (RFID) technology to "clock" *Bombus terrestris* workers in and out of their colonies. Despite the inherent problems of herding bees through an RFID reader, the studies carried out by Richard and his group have provided a wealth of "big data" which allows the foraging activities of *individual bees* to be followed. This talk was of great interest to me, as I have been working with Dan Reed (University of Newcastle upon Tyne) gathering broadly similar data over the past few years. Talking to Richard, it became increasingly clear that our results complemented one another. In particular, I was excited to hear that Richard had also observed the "waves of activity" which Dan and I had seen by deploying the Rana optical motion detection system at the entrances of *Bombus terrestris* and *Bombus hypnorum* colonies. Perhaps



The "Flapperatus"



Insect inspired UAV.



Prototype NASA insect inspired crawling Robot, Building 39, JSC

this meeting might spawn yet another collaboration here – a joint paper which pools our findings would be a really exciting outcome.

Sarah's talk gave us an insight of how gathering data for invertebrate ecological studies might be done in the future. Firstly, she talked about Rana, the motion capture system (used by Dan Reed and me in our *Bombus* studies); which has been developed by my company, Tumbling Dice Ltd over the last few years. The system has been extensively tested by scientists at Kew and also at The University of Newcastle upon Tyne, where Sarah recently completed her Ph.D. The system is effectively a robotic observer which detects motion events and then concatenates these events into a "motion" movie. Kew ecologists have been using the system to look at pollen transport in rare calcareous grassland plants, such as Pasque Flower (*Pulsatilla vulgaris*), while the studies at Newcastle have looked at the foraging behaviours of bumblebees and pollination activity in upland meadows. The overarching advantage of the system compared to human observation is that it doesn't tire or need tea and meal breaks. In addition, it can compress over a 100 hours of real time observation into less than 30 minutes of movie footage: a great help to ecologists confronted with large volumes of observational data.

Short range RFID i.d. tag on *Apis mellifera* worker.

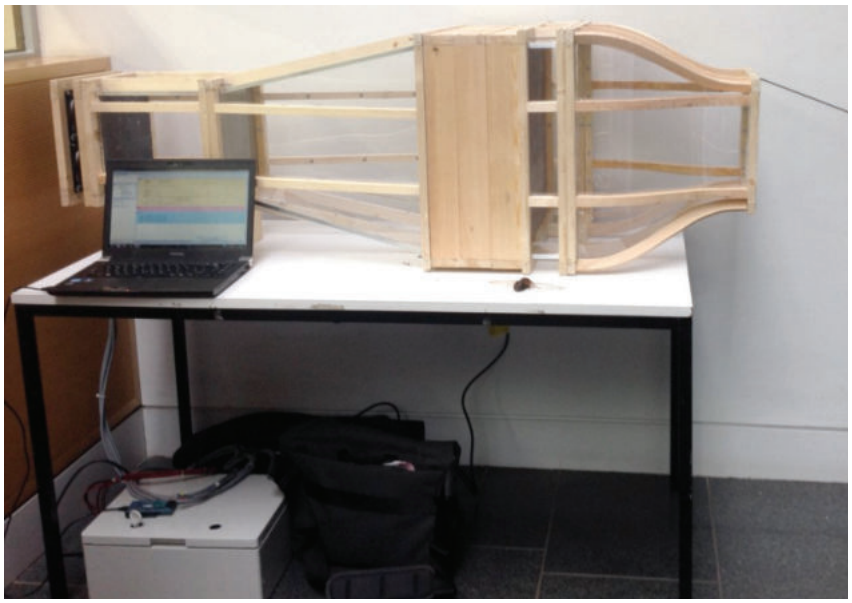
Optical i.d. tag on *Bombus terrestris* worker imaged using Rana

In the second part of her talk, Sarah described a new long range RFID technology which I have been developing in conjunction with Kew. The current technology, described by Richard Gill in his talk, has a read range of a centimetre at best: the prototype tag technology tested at Kew typically has a read range of 50cm to 1.5m (depending on how it is set up). This means that these long range tags can be used in conjunction with low cost data-loggers to collect "big data" cheaply and effectively at landscape scale. I might add, we have yet to optimise this technology, so watch this space.

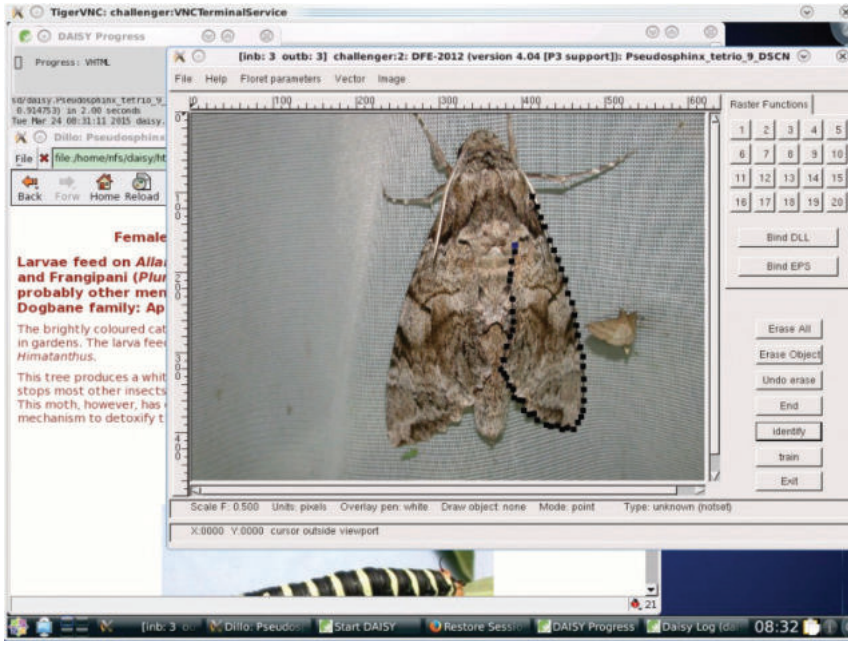
The next speaker was Steve Bachman (GIS Unit, Kew) who gave an in depth presentation which looked at the use of data collection tools which are based on mobile phone technology. Kew is currently deploying these tools to collect botanical data in Madagascar. Steve's talk covered the development history of the technology (iNaturalist), and a description of how it is currently being used to build a database of rare and endangered plants in Madagascar. He also described the potential of the system as a data sharing tool: effectively it allows para taxonomists and other interested parties in 3rd World Countries to "tap into the expertise" at centres of excellence such as Kew Gardens, The Natural History Museum and The Smithsonian Institution. "MyPestGuide" (poster presentation by Laura Fagan, Western Australia Department of Agriculture and Food) also covers many of the same bases as iNaturalist (and indeed another mobile phone observation app developed in the UK, iSPOT). These tools are great, they are easy to use and empower the citizen scientist, but from a technology perspective they lack extensible user-friendly identification tools. These tools already exist, for example DAISY, demonstrated at this SIG and also the morphometric techniques championed by Professor Norman MacLeod (Natural History Museum, London). It is clear to me that the integration of these types of tools with data collection systems like iNaturalist, MyPestGuide and iSPOT will achieve significant synergy, and free the experts to do what they do best; that is looking at complex taxonomic issues as opposed to performing routine identifications.

Montage showing Rana system deployments at Newcastle (top left) and Kew (other images).

Specimen of *Bombus terrestris* with early prototype long range RFID tag about to alight on the SIG convenor.



Showing RVC's portable wind tunnel.



DAISY making an identification of the Central American sphingid *Psuedosphinx tetrio.*

Last but not least, Justin Moat (GIS Unit, Kew) described how ecologists are now using off the shelf UAV technology to map habitats at landscape scale using a variety of techniques including Light Detection and Ranging (LIDAR) and stereo image correlation. As a Geomatic Engineer (my Ph.D. was on generating 3D maps from SPOT satellite imagery) I am delighted to see the technologies I worked with more than 20 years ago are now being made available for routine use by ecologists in the field. As Justin made abundantly clear in his talk, in addition to making maps, there is also potential for the (multispectral) imagery acquired by UAV systems to be used to assess vegetation type and health. With high resolution imaging radiometers one might be able to push the envelope even further, using the spectral signatures to identify individual plant species. It is apparent that this technology has a vital contribution to make in the emerging field of e-ecology. It is equally apparent that this technology will also be of use in precision agriculture systems (for example, to look for pest infestations or diseased crop-plants and to assess crop growth). UAV technology might also have specific applications in insect science. For example, it is entirely plausible it could be used to track (multiple) insect targets tagged using the long range RFID technology described by Sarah Barlow – rather like an AWACS system for insects.

After lunch, we re-convened for the poster session and to look at some of the technology described in the presentations actually working. The poster session included the following contributions:

An agent based model to simulate herbivore behaviour in genetically diverse crops (Elizabeth Donkin, IBERS, Aberystwyth University).

Assessing the utility of wing morphometric variation for research and insect identification (James Koh, Norman MacLeod, Richard Dee & Diana Percy, Natural History Museum).

Automated identification of Old World screw worm fly populations from wing images (Norman MacLeod, Martin Hall & April Wardhana, Natural History Museum).

MyPestGuide – the 'BEST' Biosecurity Engagement and Surveillance Tool (Laura Fagan, Dept. of Food & Agriculture, Govt. of Western Australia).

Aerodynamic performance of gliding dragonflies with 3D corrugated wings (Toshi Nakata, Royal Veterinary College).

Genetic manipulation of *Drosophila* wing morphology and its effect on flight performance (F. Albert-Davie & Richard Bomphrey, Royal Veterinary College).

Using RANA to investigate pollinator behaviour (Dan Reed, University of Newcastle upon Tyne).

Live demonstrations included a working Rana system (demonstrated by Sarah Barlow), DAISY and long range RFID tag technology (demonstrated by Mark O'Neill). In addition, the Kew GIS unit had one of their UAV's on display and the Royal Veterinary College demonstrated their new portable wind tunnel, complete with a flying specimen of *Pachnoda trimaculta*. The demonstration and poster session was a very lively affair and evoked much discussion among the delegates together with "hands on" experience of the technology, particularly DAISY (which was identifying Central American Sphingids), RANA, and The Royal Veterinary College portable wind tunnel.

I would like to thank all the

this meeting so memorable. I would also like to thank The Royal Botanic Gardens Kew for allowing us to make use of the Jodrell lecture theatre and Mia Denos (Tumbling Dice) for much hard work behind the scenes which in no small part contributed to the success of this SIG. In addition, Sarah Barlow undertook all the local organisation at the venue – without her quiet efficiency it is unlikely that the day would have proceeded so smoothly. Last but not least, I would like to thank all the delegates for attending. I hope you all enjoyed the day as much as I did. I hope to see all of you again, and hopefully some new faces as well at the next Technology and Computing SIG which will be held in 2017.

Perhaps I should leave the last word to the bees. Optimal decisions are made and creativity leaps happen when we "*seek a diversity of knowledge, encourage a friendly competition of ideas and use effective mechanisms to narrow our choices*". This is of course "the wisdom of the swarm" which, I hope was manifest in no small measure in the exchange of ideas and putative collaboration facilitated by this meeting.

Further information about the Technology and Computing SIG is available at The Royal Entomological Society web site: http://www.royensoc.co.uk/sig/eleccomptech.htm

Postscript: Using social media tools to advertise this meeting and judiciously choosing meeting theme and speakers has proved outrageously successful. The piece produced by the invited IET journalist (see http://eandt.theiet.org/news/2015/mar/bee-tag.cfm) was picked up by the BBC and appeared on the BBC News website (http://www.bbc.co.uk/news/technology-32033766). This in turn has led to a plethora of further articles and blogs. In addition, both the SIG convenor and some of the speakers have been interviewed by the BBC and overseas broadcasters; and the Twittersphere has witnessed an enormous amount of activity which is of benefit to both the SIG itself, The Royal Entomological Society, and of course Insect Science in general.

Election to Fellowship of the Royal Entomological Society

Some Members of the Royal Entomological Society have, since joining the Society, made a continuing contribution to entomological science through publications or other achievements. Such Members are eligible to apply for election to Fellowship of the Society. As a guide, election requires the kind of achievement possible over six years of productive work. Fellows of the Royal Entomological Society are able to use the suffix FRES after their name and this may be regarded as an academic qualification.

If you are a Member who would like to be considered for election to the Fellowship you need to complete the application form (available from http://www.royensoc.co.uk/membership/fellowship.htm) and obtain the support of two Fellows of the Society to nominate and second your application. If you do not have direct contact with any Fellows of the Society please send you application form to the Registrar at Mansion House as the Officers and staff will be pleased to identify a suitable proposer and seconder for your application on your behalf.

Gordon Port
on behalf of the Membership Committee

Insects in the North

Figure 1. Beetles in the Great North Museum: Hancock. Photo by Dan Gordon

This year the North of England has lots of entomological activities, including the Society's Insect Festival in York (Sunday 5 July). A new, five-year recording project has just started in the North Pennines and, in Newcastle, the Great North Museum: Hancock has a major exhibition on invertebrates. To mark these activities the Natural History Society of Northumbria and Northumberland Wildlife Trust are both running a series of entomological events. The major events are noted in the Antenna Diary Section, and further details of some key ones are given below.

The North Pennines Area of Outstanding Natural Beauty (AONB) Partnership has secured a £500,000 grant from the Heritage Lottery Fund for an exciting five year project "Cold-blooded and Spineless" to record and celebrate invertebrates in the North Pennines. Building on the success of "WildWatch North Pennines", it aims to develop people's expertise in some important and accessible groups of invertebrates to help inform conservation efforts.

This summer, free beginner-level training will be offered via six practical workshops with more advanced training in subsequent years. A range of public events will be on offer including a showcase of invertebrate inspired dry-stone wall carvings on the 22nd July at Bowlees Visitor Centre in Teesdale. You can find out more about the project and training courses at www.northpennines.org.uk/wildwatch.

The AONB Partnership will be working closely with the Natural History Society of Northumbria, regional record centres, local recording groups, Wildlife Trusts and many others to ensure records are verified and then put to good use. If you feel that you could help by offering training, leading a field outing or you would like to book a place on a workshop then contact Sam Tranter 01388 528801 or samantha@northpenninesaonb.org.uk.

The Great North Museum: Hancock exhibition "Spineless" will be a great opportunity to showcase some of the Natural History Society's fantastic collections (Figure 1) while helping museum visitors to learn about the importance of invertebrates in an engaging way. It will run from 1st of August until the 1st of November.

An exciting events programme will accompany the exhibition, with lots of opportunities for visitors to get close to live invertebrates and hear from experts involved in many different fields of invertebrate research, including Erica McAlister, Curator of Diptera at the Natural History Museum. You will be able to find details of events closer to the exhibition opening at www.twmuseums.org.uk/great-north-museum.html

The Natural History Society of Northumbria run an annual event, "Bugs and Botany", in collaboration with the Royal Entomological Society and Newcastle University and this year it is on Saturday 20 June. The event has moved from its old venue, Close House in the Tyne Valley to the new Cockle Park Science Centre near Morpeth (Figures 2 and 3). In addition the Natural History Society are running workshops on bees, hoverflies, and preserving and curating insects at the

of the Natural History Society of Northumbria's programme can be found at http://www.nhsn.ncl.ac.uk/activities-ttea.php

Finally, Northumberland Wildlife Trust is running a series of invertebrate training courses to help you learn how to identify local species. We hope to train people up that are confident to do surveys and submit their sightings to the relevant recording schemes. This will help us to make a more concerted effort to get a better understanding of insect distributions in Northumberland, as sightings can often be sparse with the colder weather! For more details on the courses and events we offer and to book your place go to www.nwt.org.uk/whats-on

Gordon Port

Figure 2. Alex Wilkinson with a peppered moth, *Biston betularia* at Bugs and Botany 2014. Photo by Gordon Port

Figure 3. Examining the contents of pitfall traps at Bugs and Botany 2014. Photo by Cecilia Port

PGF2015 attendees. Photo: Maurizio Benelli; inset: PGF2015 External Sponsors

An early-career entomological gathering: #PGF2015

Charlotte Rowley, Francisca Sconce, Joseph Roberts and Victor Brugman

Fifty-five entomologists attended this year's Postgraduate Student Forum on February 16th and 17th 2015 at the London School of Hygiene and Tropical Medicine. One of the largest forums to date, (not quite beating Luke Tilley's 2009 record of fifty-eight delegates), students gathered from around the UK and from far off places such as the Czech Republic and Italy. We pored over sixteen student posters, listened to sixteen student talks, and heard from five invited senior entomologists on our theme of science communication.

Kicking us off on an interactive tone with 'Media bites' was our first invited speaker, the London School's James Logan, who asked for volunteers who thought they were unattractive or attractive to mosquitoes. A live experiment proved the opposite for both 'guinea pigs' and James then told us about his first media experiences during his PhD and over his subsequent research career. He highlighted the importance of communicating a simple story to journalists and that an effective story can result from things going wrong, as the high number of viewers watching his escaping mosquitoes in a live interview showed!

We then had four student talks relating to ecosystem services and pests: Thomas Wood talked about agri-evironment schemes and bumblebee populations, Rachel McDonald told us about landscape ecology and apple orchard pest control, William Garood talked about his research on brown planthopper pesticide resistance and Jasmine Parkinson told us about citrus mealybug microbial symbionts.

After coffee our second invited speaker, Adam Hart from the University of Gloucestershire, talked about the 'The importance of saying yes!' - grabbing opportunities as they arise and remembering that everyone you work with is a potential future collaborator was useful advice. He was also open about his lack of the steely focus needed to be a solely research-focussed entomologist. Adam chose to take a more teaching-focused position and now juggles lecturing, research and outreach, combining all three where possible with initiatives such as the Society of Biology's 'Flying ant survey' and 'Spider in da house' citizen science initiatives.

The next four student talks covered a range of ecological topics: David Hopkins talked about host plant chemical ecology and pea aphids, Chris Jeffs gave us a review of climate warming and host-parasitoid interactions, Hasan Mohammad Al Toufailia told us about honey bee hygiene behaviour and pathogen load and Paul Davison talked about latitudinal size variation in sweat bees.

Our third invited speaker, Erica McAlister from the Natural History Museum, warmed us up for the evening with 'We need to talk'. Erica showed us some very charismatic 'fluffy fly' images, as well as imparting anecdotes about 'Insect sex' talks at the museum's Dino Snores for Grownups events and appearing on Radio 4's Museum of Curiosity. Erica's top tip to us students was to make use of the wealth of knowledge on insect ecology and behaviours amongst amateur natural history societies, recommending in particular the friendly team at the Dipterist's Forum.

Discussions and networking, aided by wine, followed around the student posters in the foyer, with research topics ranging from disease vectors,

Top: Hanna Wickenden Talk, photo: Victoria Burton; middle: Ento Pub Quiz Winners, photo: Jordan Ryder; left: Ailie Robinson, RES Talk Prize Winner, photo: Francisca Sconce.

management, insect conservation and insect behaviour. We were then off to the Blue Lion pub in nearby Holborn for our conference dinner, accompanied by Victor's entomological pub quiz which included questions on which insects have been to space and a sneaky trick question about which insect transmits Lyme disease (ticks have too many legs, apparently).

Bright and early on Tuesday morning our fourth invited speaker, Richard 'Bugman' Jones, regaled us with his knowledge of entomological writing. Emphasizing the importance of telling a good story whilst not oversimplifying the science, Richard highlighted the fact that though the general public may not have an entomological background, with good science communication they can still understand high level concepts and tolerate the use of scientific jargon such as Latin names.

Our next session of student talks covered insect distributions and responses to ecosystem disturbances: Maurizio Benelli talked about the spread of the Harlequin ladybird, Hanna Wickenden drew us into her world of sand martin flea hybrid species, Elizabeth Raine told us about Bornean dung beetle morphology and behaviour and Sarah Scriven talked about oil palm plantation effects on tropical butterfly dispersal.

Luke Tilley, from the Royal Entomological Society, encouraged us all to take part in entomological outreach and to of course join the Society! In particular Luke highlighted the greatest value of membership: with a wealth of different disciplines within entomology ranging from biochemistry up to population ecology, we are all still connected by our common interest in the insect taxa.

After our next caffeine pit stop our fifth invited speaker, Mary Cameron from the London School of Hygiene and Tropical Medicine, gave us a healthy dose of realism about academic entomological careers. Detailing her progress up the 'greasy pole' she underlined the dedication needed to keep going, and explained that for her it is the opportunities to make an impact of people's lives, lifelong learning and collaboration with researchers around the world, that really makes it worthwhile.

The final session of student talks, fittingly for our venue at the London School, was on the theme of medical entomology: Adriana Adolfi talked about analysing *Anopheles gambiae* insecticide resistance *in vivo*, Nelson Grisales told us about assessing bi-treated bednets to manage mosquitoes in Burkina Faso, Josephine Parker showed us some flight videos from her research on mosquito tracking and lastly Ailie Robinson told us about her research into the chemical signalling of malaria parasites.

Accompanying Tuesday's lunch, we had the announcements of the Royal Entomological Society prizes for the best student talks and posters as judged by the senior entomologists and, new for this year, separate prizes voted for by our student delegates. Runner-up for the RES poster prize was Robin Southon, joint runners-up for the student-voted poster prize were Bryony Sands and Ashwaq Alnazawi, and winning both the RES and student-voted poster prizes was Nichola Plowman. Runner-up for the RES talk prize was Chris Jeffs and joint runners-up for the student-voted talk prizes were Maurizio Benelli and Elizabeth Raine. Winner of the RES talk prize was Ailie Robinson and winner of the student-voted talk prize was Josephine Parker.

As Postgrad reps, running the Forum was very rewarding if not thoroughly exhausting; we hope that all who attended this year's Forum enjoyed themselves. We wish to thank all student poster and talk presenters, our invited speakers, Kirsty Whiteford at the Royal Entomological Society for managing all the paperwork and finances and the London School of Hygiene and Tropical Medicine for hosting us. We also wish to thank our sponsors for their support: Koppert Biological Systems UK, Syngenta Bioline UK, BCP Certis, ARCTEC and NHBS. The 2016 Postgraduate Student Forum will be held at Harper Adams University - we look forward to seeing you in Shropshire!

Student Essay Competition 2014

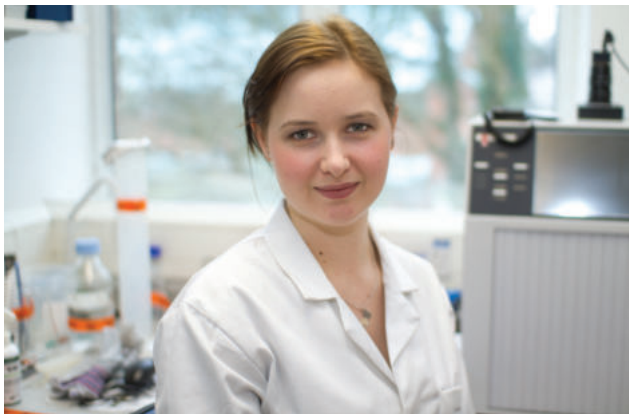
Each year the judges face the difficult task of deciding which are the winning essays. 2014 was especially difficult - a bumper year with 44 entries all of which were of an extremely high standard. It was rewarding to see six entries from outside of the UK and the Society hope that the number of overseas entries will continue to grow. Congratulations to the winners and runners up but also to all of the entrants on the wide range of topics selected and the fascinating array of styles presented. The judges are now eagerly awaiting 2015 submissions and I understand that at least one entry has already arrived. So with the summer vacation looming, now is the time to sit down and write that winning essay.

Peter Smithers

1st Prize

Minions required for symbiotic partnership (with the possibility of leading to garden domination) – see host for details

Jasmine Parkinson, University of Sussex



We all need a little help at times; a PA with the skills and knowhow to help us overcome those daily challenges which we cannot face alone. For you, these challenges might be fixing the plumbing or navigating a new gadget. You may consider yourself a Jack-of-all-trades or a finely tuned specialist, but either way, teaming up and gaining a boost from a friend now and then can save you a lot of time and hassle. The life of an insect is not so different in this regard.

It's a tough old world, and insects need all the help they can get to survive, squeeze out babies for the next generation and keep them alive, all whilst trying to keep up with the Joneses by outcompeting their neighbours. Sap-sucking insects, like aphids, whiteflies and mealybugs (the bane of gardeners worldwide) know this all too well. Throughout their lives, they consume nothing but sap found in the stems of plants, and that poses a serious predicament. Sure, this oozing liquid is full of sugars, but there is hardly any protein to be had in it. Not enough to sustain a growing insect that wants to multiply and take over your prized petunias. It would be like a person trying to live off jelly babies. The solution to this imbalanced food source is tantalizingly so near, and yet so far. Proteins can be made from ingredients found within the sap if you have the right chemical kit, but the insects don't know how to. They literally lack the genetic blueprint necessary to perform such a reaction. For these little blighters, it really is a case of water, water everywhere, but there's nary a drop to drink.

They could hang up their hats and give up, but evolution has a nifty way of working around problems like these. What the sap-suckers need is a sophisticated sidekick to manufacture protein for them, and they acquire it from the most unlikely of places: bacteria. No, the insects have not been drinking Yakult; they have formed symbiotic relationships with specialised micro-organisms. These bacteria actually live inside the insects' bodies quite happily, like tiny hordes of minions, busily harvesting proteins from the sap their hosts eat. You may wonder what the bacteria gain from this relationship, and the answer is a nice home with relatively constant conditions compared to the harsh outside climate, as well as a ready supply of sugars and other nutrients which they can use as they please. The mothers transfer some of these bacteria to their offspring, thus perpetuating the relationship down the generations. It's a bizarre but effective strategy to help both the insects and the bacteria exploit a source of food and an ecological niche that neither of them could achieve alone.

Insect-bacteria symbiosis is a remarkably common strategy, and it's not just for nutrition. Minions can also serve as a potent source of protection from predators. Arch-nemeses of aphids are the parasitoid wasps. These aren't the black and yellow varieties that plague your picnic table; by comparison, parasitoid wasps make those stinging jam-bandits resemble harmless butterflies. Parasitoids will inject their eggs directly into the aphid's body, where they hatch into wasp larvae that eat the victim from the inside before bursting out, a bit like the film Alien. Death by baby parasitoids is a nasty way to go for any critter, but fortunately there's a minion for that. Many aphids harbour a second species of bacterium (which also works alongside a friendly virus just to shake things up a bit). Together, these little helpers will prevent the wasps' eggs from hatching and developing inside the aphid so that it can live another day and produce more babies of its own. Great success!

Not to be outdone, mealybugs have gone a step further in convoluted associations. They have two types of symbiont helpers to assimilate protein from sap, one of which lives inside the other. It's the only case of a bacterium living inside another bacterium, like microscopic Russian dolls, or if you prefer, minion inception. Millions of years of living the easy life have led to an obligate dependency within this trio, and many biochemical pathways now require contributions from all three members. This renders the mealybug-symbiont "holobiont" into a three-legged stool. If one leg is kicked away, the other two will surely fall.

If you think that this whole business sounds rather twisted, you need look no further than your own cells. Each contains mitochondria, tiny factories that perform respiration and allow you to gain energy from glucose and oxygen. The evidence overwhelmingly indicates that these organelles were once free-living bacteria that formed a symbiotic relationship with eukaryotic cells hundreds of millions of years ago. So it's fair to say we all carry little minion hordes of our own.

Email: jp384@sussex.ac.uk

2nd Prize

Bee-haviour in the Rainforest

Hannah Michie, The University of Aberdeen

What did you see in the rainforest?' my little sister asked excitedly, expecting a story about being chased through the foliage by a hungry jaguar.

'Do you want to know the best thing I saw?'

Her face lit up with excitement.

'It was a bee.'

She scrunched up her nose. 'How can a bee be exciting?'

'The bees I caught, I could hold between my fingers.'

'Didn't they sting you?'

In fact it is only female bees which are capable of using their sting as a defence mechanism. This is because the sting comes from an ovipositor, the organ female bees' use for laying their eggs. But these were not just male bees.

'Not these bees,' I smiled

'What did it feel like?'

'Like a tiny finger massager.'

Bees make a buzzing noise because their wings beat the air and create wind vibrations. The characteristic buzz is also associated with bumblebees as they shake the middle of their bodies in order to attach the pollen from flowers.

'They don't sound as exciting as jaguars. I bet they didn't have black and yellow spots.'

'No, but they were blue and green coloured!'

Out of the four orchid bee types known to be present in Cusuco National Park, Honduras, where I was researching, only one genus, *Eulaema*, are typically black and yellow striped whilst *Euglossa*, *Eurifesea* and *Exaerate*, are all a fantastic metallic blue and green.

'Many insects, and animals, are brightly coloured to deter other animals from eating them. This is called aposematic colouration.'

'They aren't bumblebees, are they?'

'There is a very specific way in which different species are named according to their Kingdom, Phylum, Class, Order, Family, Genus and Species. I remember this by simply thinking that this is how we are Keeping Precious Creatures Organised For Grumpy Scientists!'

She laughed.

'The most common species I collected was *Euglossa imperialis*.'

'Do they still make honey?'

As with many bee species, *Euglossa imperialis* do have corbiculae, pollen baskets, on their back legs which are little hollows surrounded by hairs in which pollen is collected. They live in mud nests, typically underground, and therefore have no need to support a hive or queen.

'I'm afraid they don't.'

'How did you catch them? You could just leave out bait for a jaguar!'

'These bees are actually attracted by different scents.'

Orchid bees are attracted to certain species of orchids which excrete strong fragrances. This is a type of mutualistic behaviour as both species benefit from the interaction – the bees receive pollen and the pollinarium from the orchid are dispersed.

'We set up cotton wool buds hanging from overhead branches soaked in different strong scents. These included eucalyptol and vanilla extract and once the bees were hovering beside the bud, the bees were caught in nets.'

'Do the bees still live together, in hives?'

'No, they like to live alone.'

Unlike Meliponini, another tribe of stingless bee, which are typically eusocial, Euglossini are actually solitary insects.

She seemed disappointed by this.

'Jaguars also live alone,' I added.

'How do they ever find a mate?'

'That can be quite difficult as some orchid flower physically mimic a female bee in order to attract the male to the flower!'

There is ongoing research into why male bees specifically are attracted to fragrances more than females. Curiously, they are also strongly drawn to non-nectar bearing flowers. One hypothesis is that these fragrant substances are actually converted into sex pheromones, behaviour altering chemicals, which then heighten the bee's ability to attract females. Additionally there is the increasingly common belief that these fragrances are stored in a structure on the hind legs of the bee which are then released when in the presence of a female. Either way male bees participate in lek behaviour.

'Male bees put on a display to attract females. Many species attract mates in this way.'

'Do they hunt like jaguars?'

'Well they still eat nectar, so don't kill to eat, but out of jealousy and competition, females demonstrate kleptoparasitic behaviour which means that they kill the eggs and larvae from other orchid bee species!'

'Why are you so interested in these bees?'

'When I was in Honduras, there were lots of different species of plants and animals, including jaguars,' I teased. 'But we know an awful lot about these bigger mammals. Every day we discover new species of organisms, including bees, and I want to add to this area of knowledge. Who knows how useful they may be in the future?'

'Will I ever get to see one of these bees?'

'Unfortunately, Euglossini are only found in the Neotropics – just like jaguars! So unless you go to South America then, unfortunately, you won't.'

'They might not be as big as jaguars, but your green bees sound pretty amazing!'

Email: Hannah.michie@blueyonder.co.uk

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3rd Prize

A Brief Guide To Successful Dung Beetling

Paul Manning, University of Oxford

I am trying to calculate the volume of water inside my boots. It has been raining for the past several days, and the narrow path winding through the gorse and heather has transformed into a muddy river. Despite my best waterproofing efforts, I am completely saturated. Wearing a pair of fluorescent green rubber gloves and armed with a silicon spatula, teaspoon, butter knife, and a fish food container, I look more like an animated kitchen drawer than a scientist.

As an agricultural ecologist, I am interested in understanding how agricultural intensification impacts diversity of farmland invertebrates along with the services they provide. Today, I am collecting dung beetles for an experiment that will attempt to measure their sensitivity to soil cultivation. I scan my surroundings, scoping out my next target.

Suddenly I spot it. Just meters away, positioned innocuously within small patch of tightly grazed sward: the perfect cow pat. From where I stand, it looks to be about a week old. The structure of the dung is indicative of the diverse diet of the cattle grazing the rough commons. The land slopes gently to the south, and a portion of the dung is shaded by an overhanging branch. After poking through thousands of dung pats, one begins to get an eye for what makes an ideal habitat. To me, this pile of digested herbage looked like a dung beetle mecca.

Step 1: Have no shame

Gingerly stepping through the heath, I crouch down to get a closer look. Suddenly I slip and fall forward, just managing to catch myself with my forearm - my face is inches from the dung pat. I raise my head to see if anyone has witnessed this spectacle; a pony stares blankly back. Laughing quietly, I discard any shred of dignity I had remaining and roll onto my side, folding into the snug space between the dung pat and the spiny gorse.

Step 2: Make the most of your toolkit

I remove the butter knife from my pocket. Gingerly, I make a shallow cross-shaped incision along the top of the dung pat. Slipping the knife-edge under the crust, I peel back the first layer. Within this unlikely habitat is a diverse and active insect community. Dozens of water beetles quickly retreat into the dung in a brilliant wave of scuttling mahogany. I am not here for them today.

Observing the dung, I notice a small movement. A slow, clumsy twitch of a leg that can only mean one thing: a dung beetle. Using my teaspoon, I carefully remove the beetle from its home. I know this species to be *Aphodius ater* – a dwelling dung beetle measuring approximately 4-mm in length that is often found just below the dung crust. It's difficult to hold back a smile when looking at this beautiful little scarab. I place it in my container along with others collected earlier.

Step 3: Think like a dung beetle

I move deeper into the dung pat. Using my spatula, I sieve down through the layers soon finding an orange dung beetle recently revealed to be two cryptic species: *Aphodius pedellus/fimetarius*. Eventually, soil and yellowed vegetation begins to peek through the dung. A familiar bulbous black shape appears half buried within the soil and gently I pry it up: *Aphodius fossor*. This one is a female, but the male usually isn't very far. I use my spoon and carefully scrape below where I found the first. Three males appear… looks like trouble in paradise. I hold them in my hand, watching as they lumber along with a bodybuilder-like gait. Had I have not been as thorough, I would have missed these fellows.

Step 4: Be patient

The rain has subsided and the sun has appeared for the first time in several days. A faltering buzz answers the intermittent silence between the gentle *'chink'* of stonechats conversing from the undergrowth. Suddenly something large whirs past my head and crashes into the dung pat, capsized by a forceful landing. I am delighted to see that *Geotrupes stercorarius* has decided to pay a visit. Her underside gleams a mesmerising iridescent blue. Clubbed antennae waving, she rights herself and tunnels methodically into the dung. This species is scarce, and I won't find sufficient numbers for my experiments. Instead I watch in silent awe, imagining her excavating tunnels, burying dung deep within the soil.

I pause to shoo a yellow dung fly which has landed on my cheek – confirming my suspicion that despite torrential rain, I am in desperate need of a shower. Beetles in tow, I make my way back to the farmhouse. Pausing at the door, lost in thoughts of scarabs and experimental design - I pull off my boots and tip approximately 400-mL of water into the garden.

E-mail: paul.manning@zoo.ox.ac.uk

Runner Up

'Taking Out The Bins': Lessons From Our Hymenopteran Cousins

Gabriella Kountourides, University of Leeds

As a child of divorced and remarried parents, there has been no shortage of familial disagreements in our households. One of the biggest causes of arguments is who does the chores? Divorce changes humans' views of family but the insect world also has different types of family and I think that my metaphorical essay will make both issues slightly simpler to understand! This article can help children like me win those arguments – using as evidence, the family structures of particular insects (hymenopterans) and kin selection theory, to help rationalise this common problem. It might also unpick some of the complexities of hymenopteran societies within social insect biology which is an important contributor to other aspects of sociobiology.

First things first: the differences between humans and insects. Humans are diplodiploid, which means that men and women have two full sets of chromosomes (23 pairs to be exact). Hymenopterans, one of the largest orders of insects, which includes the highly social group of ants, bees and wasps, are haplodiploid. If we use the example of the ant, it means that whilst female ants have the usual two full sets of chromosomes, male ants have only one set. This is called "haplodiploidy" and is one of the most important things to understand about ant (and all other hymentopteran) genetics.

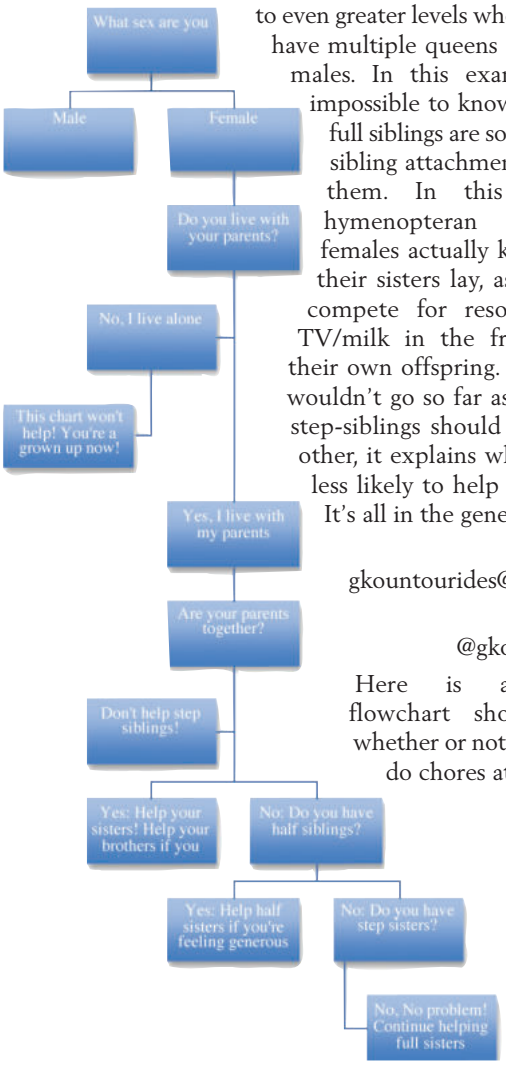
Daughter ants - like their mothers - are diploid, coming from fertilised eggs and a 50:50 mix of their mother and father, inheriting equal numbers of chromosomes from both parents. But male ants are trickier (as they are in all species!), they are only descended from their mothers as they come from unfertilised eggs. This means they will develop with half the chromosomes (haploid). So all ant offspring are 50% related to their mothers, but sisters are related to each other even more, by 75% while they are only related by 25% to their brothers. And somewhat tragically, male ants have no fathers.

This is important, because of kin selection theory, which hypothesises that an individual is more likely to help a family member than a stranger, as it brings them benefits since their DNA is at least partially passed on. For example, your grandparents take you out to tea, it is in part because they like you, but also because *you are family*. They are unlikely to take a stranger out…why spend their money on them? But 'blood is thicker than water' and it's in their interest to ensure their children and grandchildren are looked after, and survive, otherwise the family would die out.

So back to chores. In a "traditional" monogamous family unit, ant sisters help raise each other's young, as well as their mother's young; think of it as helping change their nappies. And the female ants are more closely related to their sisters' sons (as only the queen ant can mate, the majority of ants lay unfertilised eggs that can only develop into sons) than their real brothers - 37.5% as opposed to 25% genetic relatedness. So they are most likely to help their sisters, then their sisters' sons, and very unlikely to help their brothers as they are far less related. So in this case, you are likely to help your sister unload the dishwasher, and her son, but very unwilling to help your brother! So now I can tell my parents the reason I don't help my brother is genetic and be sure to win the argument!

Ancestrally, hymenopterans are monogamous, a queen ant will only mate with one male. Monogamy is particularly useful for males in societies, as they can be certain that any offspring are their own. But further down their evolutionary line, some insect females start to discover the benefits of mating with more than one male as the males, desperate to mate, will give her all sorts of bribes to encourage her to select them. Honey bees are good examples of this behaviour.

So, what happens if you have a promiscuous mother? Well, the relatedness between sisters drop further, to 25% (the same as a brother). So this means you will help both your half sisters, and your real brothers equally - and less than you would help your real sister.



Now some insects take promiscuity to even greater levels where colonies have multiple queens and mating males. In this example, it is impossible to know who your full siblings are so you feel no sibling attachment to any of them. In this type of hymenopteran society, females actually kill the eggs their sisters lay, as they now compete for resources (the TV/milk in the fridge) with their own offspring. So whilst I wouldn't go so far as to suggest step-siblings should harm each other, it explains why they are less likely to help each other. It's all in the genes!

Email: gkountourides@gmail.com

Twitter: @gkountourides

Here is a helpful flowchart showing you whether or not you should do chores at home.

Runner Up

Fine-Dining and Rohypnol: The Molecular World of Insect Sex

Ben Hopkins

Before embarking on his date, a man opens his medicine cabinet and inspects his options. Adorning its shelves are a number of phials branded with cryptic names and filled with corrupt contents. Which will he slip into his partner's drink? Perhaps Acp70A to reduce her interest in sex with other males? Or maybe ovulin to increase the likelihood of fertilisation? Perhaps an anti-microbial peptide? Or HezPSP to stop her producing sex pheromones? Of course, I barely need mention that the usage of such a drug cabinet by a human would be utterly deplorable but for the males of many insects, this nefarious arsenal is available. However, the receipt of these compounds is not via their partner's drink but through the act of copulation.

The ejaculate is a bewilderingly complex construct composed of far more than just sperm. An insect's 'love potion' may contain all manner of protein types from antioxidants, through prohormones, to lectins, and a suite of lipids, salts, sugars, and even non-sperm cells including microbes. A particularly important subset of these ejaculate components are the so-called 'seminal fluid proteins' (Sfps). These 'tokens of love', as they were poetically and somewhat ironically referred to by Mariana Wolfner, have wide-ranging functions that all serve one purpose: to boost the reproductive success of the male. In some cases, the action of seminal fluid components may be mutually beneficial. Male bushcrickets (Orthoptera: Tettigoniidae) transfer a spermatophylax, a rather unpleasant sounding globular mass that is consumed by the female. Whilst not everyone's idea of fine-dining on a date, this secretion is highly nutritious and serves to enhance the size and number of eggs she lays, which, evolutionarily speaking, is good news for both.

However, it's often the case that these ejaculate-transferred compounds have a decidedly one-sided effect on reproductive success. The paradigmatic example of an Sfp is the fruit fly *Drosophila melanogaster's* 'sex peptide' (or Acp70A), which interacts with a specific class of receptors in neurones innervating the female reproductive tract. Upon receipt of this molecule, female behaviour is reprogrammed: they reject courting males, feed more, lay more eggs, and sleep less. Through this process, the males dramatically lower the risk of their sperm having to compete with those of rival males, thus ensuring certainty of paternity, and effectively turn their mates into efficient offspring-producing machines. Fruit flies are clearly unmoved by Oscar Wilde's quip 'the very essence of romance is uncertainty'. Exposure to this little protein and a number of other Sfps is toxic and, if all of the other manipulative effects weren't enough already, the females die younger. This antagonistic interaction is representative of a phenomenon known as 'sexual conflict' in which the fitness of the male and female within a partnership cannot be simultaneously maximised. That is to say, in pursuing a strategy that increases the number of viable offspring, an individual prevents their partner from realising their own ideal.

There are many other ejaculate-mediated effects across insect species including stimulating rapid female engorgement in feeding ticks (*Amblyomma hebraeum*), altered flight behaviour in honey bees (*Apis mellifera*), and structural and conformational changes of the female reproductive tract in *D. melanogaster*. Furthermore, there are many on-going systematic analyses to fully characterise the composition of the ejaculate and the functions of its individual components as exemplified by Mariana Wolfner's, ahem, seminal 1997 review.

There is a feminist movement currently circulating on social media using the tagline 'I need feminism because…'. One follow up to this opening reads 'science toys shouldn't be in the boys section' and it now seems as though female insects agree for evidence is mounting that they have their own toys at their disposal to retaliate with. Cryptic female choice describes the process by which females can influence the outcome of a mating post-copulation. This occurs through sperm usage and storage by multiply-mated females who may selectively fertilise eggs with the sperm of the sexiest fathers. Work on the spider *Pisaura mirablis* has shown that females retain more sperm via female choice mechanisms from matings with males who transfer a nuptial gift relative to matings with males that don't, the insect equivalent of 'gold- digging'. Further studies on the red flour beetle (*Tribolium castaneum*) have shown that females preferentially use the sperm of males who rub their legs at higher intensities on the female wing cases and, I mean, who can blame them?

Margaret Sanger once wrote that 'no woman can call herself free who does not control her own body' and it is tempting after reading about the insect male's arsenal to conclude that females have it hard in the molecular world of insect sex. But this hot new topic of cryptic female choice is starting to suggest that we needn't worry for them. Mating isn't harmonious nor is it just a case of male manipulation; it's flat out warfare.

Email: benjamin.hopkins@linacre.ox.ac.uk

Runner Up

A Hitchhiker's Guide to Citizen Science

Chris Foster, University of Reading

A beetle sits motionless on a hogweed flower. But what is it?

During a summer's fieldwork searching umbellifers for beetles, finding a species new to me was commonplace. But this one was a complete mystery. No more than 5mm long, with rich brown wing cases reminiscent of old wood furniture, a square cream-coloured head and thorax, and antennae like strings of beads that thickened towards the tip. Back in the laboratory, I stumbled on its identification online before even opening a key. It was of the genus *Antherophagus*, in the family Cryptophagidae. Crypto: even the name of the family has a mysterious air, but with a little more sleuthing I had at least determined that this diminutive hogweed denizen was *Antherophagus pallens*.

A name is often where the trail stops. There are around 4000 species of beetle in Britain, so there's usually little else to know beyond the most basic of life history details. In the case of *Antherophagus*, however, the snippets of information I could find were intriguing. Its larvae are scavengers in the nests of bumblebees, eking out a living on scraps of nesting material and other detritus. The adult females actually lay their eggs directly in the nest. And how do they find the bees' nest in the first place? This is the good part: they hitch a ride.

Unlike most of the beetles I found on hogweed that summer, the *Antherophagus* had not been after pollen but was using flowers as the entomological equivalent of a bus stop. If a bumblebee came close enough, the beetle would grab hold of its proboscis and then cling on for dear life, only letting go when it knew the bee had returned to its nest.

Such inter-species hitchhiking is known as phoresy, and there are many other examples from the invertebrate world. Rarely is a carrion beetle without its cohort of mites, allies of the beetle that help it compete at a carcass by consuming the eggs of blow flies. Pollen-feeding flower mites are another bee passenger, using them to get from bloom to bloom, and tiny pseudoscorpions – which themselves feed on mites – can be found riding along with a variety of flying insects, fastening themselves on with a pincer.

Among the most famous insect hitchhikers are oil beetles, nest parasites of solitary bees. Each impressively swollen female lays hundreds of eggs in burrows close to where solitary bees are also nesting. Once hatched, the specialised, highly mobile larvae behave much like an adult *Antherophagus*, crawling up onto flowers where they might encounter a foraging bee. They complete their life cycle within the solitary bee's nest, consuming eggs as well as stored nectar and pollen.

Returning to *Antherophagus pallens*, now that I knew its name I could submit details online through iRecord, which connects with the National Biodiversity Network database. Taken together with other records, reports of a single beetle at a single location yield valuable information about distribution, phenology and habitat associations, and given enough data it is also possible to study changes in abundance over time. But what that doesn't capture is how the beetle interacts with the ecosystem that supports it.

Much of what we do know was worked out by simply watching animals and seeing what they did. Has basic natural history of this sort gone out of fashion? Certainly most of the notes I can find on the ecology of *Antherophagus* date back almost 100 years. I admire the patience and dedication of those who first unraveled the intricate life cycle of an oil beetle, or rifled through enough bumblebee nests to figure out that *Antherophagus* clinging to bees' tongues was not simply a freak occurrence.

Now that we're increasingly aware of how important interactions between species can be to conservation, from groundbreaking work on the large blue butterfly to recent high-profile research on ecological networks, perhaps we need to recapture something of the spirit of those old-fashioned naturalist-scientists. There are certainly plans underway to capture species interactions in biological record data, which may be a step towards recasting citizen scientists as citizen natural historians, more than mere data drones for the 'proper' scientists in research institutions.

Who knows, perhaps some hitherto unknown aspect of the locomotive interaction between *Antherophagus* beetles and bumblebees may prove useful for the conservation of one or the other. If it doesn't, wouldn't it simply be satisfying to know more? After all, whilst I have endeavoured to spin a serious point from a single observation, I only recall it so well because I was charmed by the animal, and delighted by the thought of it flying through the sky whilst dangling from the tongue of a bee.

Antherophagus pallens sits motionless on a hogweed flower. But what is it doing there?

Email: c.w.foster@reading.ac.uk

How to hold a Royal Ent Soc meeting

Archie Murchie, Honorary Secretary

This is a short set of guidelines for those who might interested in holding a scientific meeting but are unsure of how to go about it. The Society sees entomological meetings as a major part of its remit, i.e. '*the improvement and diffusion of entomological science*'. Accordingly, support (and funding) is available.

Types of RES meeting

Special Interest Groups (SIGs)
SIGs form the backbone of the Society's meeting programme. They normally consist of a one-day meeting, at intervals of every 1-2 years for each group. The schedule is flexible but usually there is an invited speaker and 6-7 offered talks, along with an area for posters. SIGs can be relatively small (20-30 people) or some can have over 100 delegates. The SIGs are coordinated by the overall SIG convenor (Dr Richard Harrington), the Honorary Secretary and the individual SIG convenors. The current SIGS are shown in the box to the right and contact details for convenors are on the Society's website.

Regional meetings
Regional meetings tend to be more general than SIGs. Regional meetings were established when the Society was based in central London, with the aim to enhance the Society's activities outside of the Capital and to provide a mechanism for local entomologists to interact. There are six regions: North, South-East, East, West, Scotland and Northern Ireland. Each region is represented by a Regional Honorary Secretary, who organises a meeting every 1-2 years.

Postgraduate (PG) Forum
The PG forum is organised by the postgraduate representatives of the Society. By tradition, this takes place in early February and is normally a two-day meeting, starting late morning of day 1 and finishing early afternoon day 2 to allow for travel and some socialising. Usually, there are several established entomologists as keynote speakers, who talk about career development, paper and grant writing and data analyses or suchlike. The rest of the schedule is given over to student presentations and posters. An evening meal is arranged at a suitable local hostelry.

Existing RES SIGs

Aphids	Insect Parasitoids
Aquatic Insects	Insect Pollination
Climate Change	Insects and Sustainable Agriculture
Electronic and Computing Technology	Medical and Veterinary Entomology
Genomics	Orthopterists'
Infection and Immunity	Post Harvest
Insect Behaviour incorporating Lepidoptera	Arthropod Cuticle* Forest Insects*
Insect Conservation	Taxonomy*
Insect Ecology	Public Understanding of Entomology*
Insect Endosymbionts	Edible Insects*

* New for 2015

Holding a meeting

If you want to hold a meeting, then firstly the subject matter must be related to entomology (sounds obvious I know… but you would be surprised). However, joint meetings with other disciplines are encouraged, e.g. in the past this has involved meteorologists, statisticians, environmental consultants, foresters, microbiologists, chemists, conservationists, etc. Second, chances are the topic can be covered within an existing SIG or regional meeting format. If this is not the case, contact the Honorary Secretary and they will advise. If your meeting idea can be fitted into an existing setup, contact the relevant SIG convenor/Honorary Regional Secretary for support and advice. They will likely tell you to go ahead. The next steps are:

1) Date and location. A nine-month to a year's run-in is a good bet for a SIG-type meeting. The bigger the meeting, the more time is required to advertise and drum-up support. A quick check of University schedules, public holidays and the proximity of similar meetings helps to avoid any obvious clashes, although some are inevitable. The location can be any suitable meeting room. The Society will cover reasonable expenses for room hire and AV facilities (check with the Registrar – he is a man who doesn't like surprises). Sometimes, it may be possible to use facilities in a university without great cost if the meeting is of relevance to research and teaching of the host. If the meeting is for more than one day, consideration should be given to suitable accommodation and somewhere to socialise in the evening.

2) Invite a speaker. The Society will cover European travel expenses and accommodation for an invited speaker (again, check with the Registrar). The rest of the meeting should be offered talks and posters.

3) Logistics. Registration and payment are dealt with by the Royal Ent Soc team at the Mansion House, so you don't have to worry about that. The Society sees scientific meetings as part of its 'public benefit' role and therefore they must be open to anyone, providing they register. The registration fee is normally set a level to cover catering costs, i.e. morning/afternoon teas and coffees and a light lunch. As a meeting convenor, you will need to provide a page of information to advertise the meeting, plus a schedule once it is arranged.

4) Organise a mechanism to solicit and deal with offered talks. Offers of abstracts need to be requested on the website and in *Antenna*. If your meeting is oversubscribed, you need a fair mechanism to select some talks and not others (which are then usually offered a poster). It is usual for a delegate list and abstract book to be available at the meeting.

5) At and after the meeting. Provide water for speakers and have a strict Chair who keeps speakers to time. Make sure that the Royal Ent Soc's contribution is flagged up: the Director of Outreach has a set of slides on the RES. The Society also asks for some photographs and a brief write-up of the meeting for *Antenna*.

Annual National Meeting and biennial International Symposium

Each year, the Society holds Annual Science Meetings, which have collectively become known as the 'Ento' series of meetings. This is a three-day conference normally held in a host University's facilities in July, August or September, with about 150-200 delegates. The conference consists of plenary speakers, offered talks, posters, workshops, a conference dinner and dance, and visits to local sites of entomological interest. Every second year the meeting is a Symposium, which means that it is focussed on a definite topic and plenary speakers contribute to a Symposium volume or a special edition of one of the Society's journals.

Royal Entomological Society 'Ento' meetings afford the opportunity to organise a conference inviting the top international players in your subject area, with well-tested administrative support and financial underwriting. Offers to host the Royal Entomological Society's Annual National Meeting / International Symposium can be sent to the Honorary Secretary (archie.murchie@afbini.gov.uk). Please provide details of location, organising committee and a brief overview of the conference theme.

SCHEDULE OF NEW FELLOWS AND MEMBERS

as at 4th March 2015

New Honorary Fellows
None

New Fellows (1st Announcement)
Dr Jane Stout
Professor David Barry Sattelle
Dr Abid Farid
Professor Matthew Gandy
Dr Sujata Martand Magdum

Upgrade to Fellowship (1st Announcement)
Mr Mark Andrew Hopp
Dr Darren Mark Evans
Ms Lesley Elaine Smart
Dr Jo-Anne Nina Sewlal
Dr Anthony James Wilson

New Fellows (2nd Announcement and Election)
Dr David Steven Hubble
Mr John Walter Phillips
Dr Shin G Goto
Mr Roger Drummond Hawkins (as at 3-12-14)
Dr Alvin M Simmons (as at 4.12-14)

Upgrade to Fellowship (2nd Announcement and Election)
None

New Members Admitted

Mr John Carter (as at 3-12-14)
Ms Hannah Reeves
Mr Stuart Robinson
Mrs Catherine Anne Hodsman
Dr Yallappa Rajashekar
Mr Richard Steven De La Barre Bodenham
Mr Josh Mcqueen

New Student Members Admitted

Mr Gavin Williams (as at 3-12-14)
Ms Natalie Pilakouta
Mr Steven Dodsworth
Mr Paul Manning
Miss Victoria Jane Burton
Ms Elizabeth Raine
Mr Michael John Munro Harrap
Mrs Hilary Conlan
Ms Ashwaq Alnazawi
Mr Kris Sales
Miss Chloe Joy Hardman
Mr Olalekan John Faniran
Mr Callum Martin
Mr Konstantinos Dagklis

Re-Instatements to Fellowship
Professor Rowaida Salah Saleh Ahmed
Dr Paul Hyman
Professor Dr Seshadri Srini Vasan

Re-Instatements to Membership
Dr M Fernández-Grandon

Re-Instatements to Student Membership
None

Deaths
Prof Dr N P Kristensen, 1967, Denmark
Mr C Ashall, 1964, Aylesbury

SCHEDULE OF NEW FELLOWS AND MEMBERS

as at 6th May 2015

New Honorary Fellows
None

New Fellows (1st Announcement)
Dr Anne Oxbrough
Professor Natarajan Chandrasekaran
Mr Christopher R Shortall

Upgrade to Fellowship (1st Announcement)
Mr Peter John Boardman

New Fellows (2nd Announcement and Election)
Dr Jane Stout
Professor David Barry Sattelle

Upgrade to Fellowship (2nd Announcement and Election)
Mr Mark Andrew Hopp
Dr Darren Mark Evans
Ms Lesley Elaine Smart
Dr Jo-Anne Nina Sewlal
Dr Anthony James Wilson

New Members Admitted
Mr Andrew John Green
Dr Bilal Saeed Khan
Dr Robert Tansey
Mr Ian Richard W Elliott
Dr Lisa Joy Reimer
Dr Elisa Rigosi

New Student Members Admitted
Ms Rachel Mcdonald
Miss Susie E Hewlett
Miss Emma Bradford
Miss Catriona Helen Mcintosh

Re-Instatements to Fellowship
Ms Densey Clyne
Professor Canute Pancras Mutebi Khamala
Professor Jayanthi Priyankara Edirisinghe

Re-Instatements to Membership
Mr Rien De Keyser
Dr Muhammad Mazhar Ayaz

Re-Instatements to Student Membership
None

Deaths
Mr T G Howarth, 1939, Dorset

J. O. Westwood Medal and Award for Insect Taxonomy

CALL FOR NOMINATIONS

In response to the urgent need to expand the research effort in insect taxonomy and to encourage monographic revisionary work, the Department of Entomology of the Natural History Museum, and the Royal Entomological Society, launched a new joint award for excellence in insect taxonomy in 2006. We plan to award the medal biennially for the best comprehensive taxonomic work published on a group of insects or related arthropods, typically a taxonomic revision or monograph, as judged by an independent international panel of experts and agreed by representatives of the two organisations. The award of this medal recognises only the highest standards of descriptive taxonomy. The winner of the 2014 award was Prof. Lee Herman for his monograph entitled 'Revision of the New World species of Oedichirus (*Coleoptera*, *Staphylinidae*, *Paederinae*, *Pinophilini*, *Procirrina*)' (*Bulletin of the American Museum of Natural History*, no.375. 2013). The work was of the highest standard by a gifted scientist and is an outstanding addition to insect taxonomy.

We here announce that the fifth award will be made in 2016 and for which we now request nominations. The medal will be awarded for an outstanding recently published revision or monograph on a group of insects or related arthropods. The work nominated should have been published between 1st January 2013 and 1st January 2015. It is open to authors from any country in the world who demonstrates the highest standards in descriptive taxonomy in the work nominated. All interested in applying themselves, or in nominating another author, should submit a nominating letter, letters of support from two acknowledged experts, and at least one copy of the work by no later than 30th September 2015, to **Dr Andrew Polaszek, Department of Life Sciences, Natural History Museum, London SW7 5BD, UK**, clearly marked 'Westwood Award' or electronically to **<A.Polaszek@nhm.ac.uk>**. We shall hope to announce the winner early in 2016 and make the presentation at Ento '16.

The award has been named in honour of the leading 19th century British entomologist, John Obadiah Westwood (1805-1893). Westwood was the inaugural holder of the Hope Chair of Entomology at the University of Oxford, when it was established by the Reverend F. W. Hope in 1863. Westwood was one of the original group of founding members of the then Entomological Society of London in 1833 and served as President for three separate periods, 1851-52, 1872-73 and 1876-77. In 1883 he was elected to the unique position of Honorary Life President of the Society. He was a prolific author and published on most groups of insects and illustrated his own works, and those of many others, with his exquisite drawings and paintings. Perhaps his most influential work was *An Introduction to the Modern Classification of Insects* published in two volumes in 1839, pp 1-462, and 1840, pp 1-587, by Longman, Orme, Brown, Green and Longmans, London. As a major appendix to Volume 2 he added his *Synopsis of the Genera of British Insects*, pp 1-158. In this latter he first clearly established the concept of a type species for a genius, analogous to the type specimen for a species, and thus helped to provide a stable foundation for insect nomenclature. It is particularly appropriate that our award should be dedicated to this early pioneer of insect taxonomy.

Book Reviews

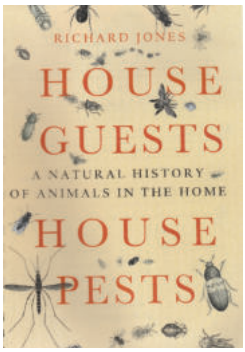
House Guests and House Pests
A Natural History of Animals in the Home

by Richard Jones

Bloomsbury Publishing

£16.99

ISBN 9781472906236



"House Guests and House Pests" is an exploration of the place that we humans call home. It examines the development of our choice of overnight shelter through the lens of the invertebrates that have shared both our homes and our history. "House Guests" weaves the biology of our many invertebrate lodgers into the complex story of human evolution.

The book opens with the concept of the home as a sacred space that is sacrosanct to the occupying group of humans. It then tracks our shift from hunter gatherer to permanent settlements and primitive agriculture. It charts the opportunities that we humans have created for our invertebrate house guests and documents which of them took advantage of us and when; from the body lice that moved in to take advantage of the animal skins worn by Neanderthal and Cro-Magnon man between 100,000 and 40,000 years ago, to the acquisition of our very own human flea that we picked up as we entered America just 14,000 years ago.

The book is divided into nine chapters, with the initial ones dealing with the development of the human home while the subsequent chapters take specific resources within the home and examine the invertebrate fauna that has utilised it. These include; household wastes, stored foods and the house itself. Chapter seven is more focused and looks at us the human occupants of our homes as a resource.

The appendix is a catalogue of animal house guests, which is intended to help home owners identify the particular guest they are dealing with. It illustrates each group of animals along with a brief outline of their biology, leaving the decision to tolerate or evict them to the reader.

"House Guests" is an insightful, informative and entertaining introduction to the animals that we share our homes with. While it has a distinctly entomological focus it also offers a wider perspective which includes the birds and mammals that have moved into our personal space. "House Guests" will offer the reader a fresh perspective on their homes and their invertebrate house guests which will hopefully lead to a more tolerant relationship between home owner and guest.

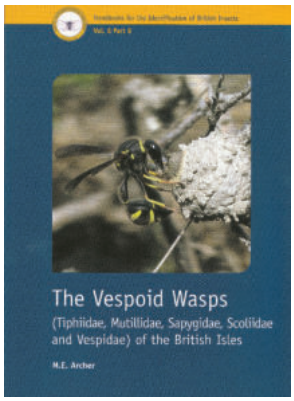
Peter Smithers

Handbooks for the Identification of British Insects
Vol. 6 Part 6 The Vespoid Wasps (Tiphiidae, Mutillidae, Sapygidae, Scoliidae and Vespidae) of the British Isles

M.E. Archer

ISBN 978 0 901546 98 2

Royal Entomological Society 2014



This handbook covers the Tiphiidae, Mutillidae, Sapygidae, Scoliidae and Vespidae. The introduction gives a brief history of works related to the identification and study of these wasps in Britain and includes a table of distribution by country. It is followed by sections on the status, conservation and economic importance.

With their complex body structure aculeates have acquired a large terminology relating to their external structure. This can be confusing for beginners as different names are often used for the same body part by different authors. It is good to see that those of importance when attempting to identify these insects are clearly described and illustrated here. A full checklist of the British species is given with a brief glossary covering life-cycle terminology.

The initial key separates out the other main groups of Aculeates, e.g. the Apoidea, Chrysidoidea and Formicidae. This is followed by well-illustrated keys to the families and genera. These, used alongside the colour plates of whole insects provided, should enable specimens to be easily placed in the correct genus. Most of the genera contain few species so identification to species should then be straightforward. The Ancistrocerus are perhaps the most difficult to identify and personally I have struggled to correctly identify these in the past. They are an inherently difficult group but armed with this key I now feel more confident in tackling them. The species accounts summarise the key identification features of each species. A brief account of the ecology, its prey and associated parasites is given.

My interest in the behaviour and ecology of insects has naturally drawn me towards this group of wasps, especially the heath potter wasp *Eumenes coarctatus* that I have spent the last five summers studying. One interesting fact I learnt is that social wasps were carriers of *E. coli* and *Salmonella* so will be more diligent in washing fruit in future! The publication of this excellent Handbook will hopefully introduce many more entomologists and general naturalists to seek out and study these fascinating insects.

John Walters

The Dragonfly Diaries: The Unlikely Story of Europe's First Dragonfly Sanctuary

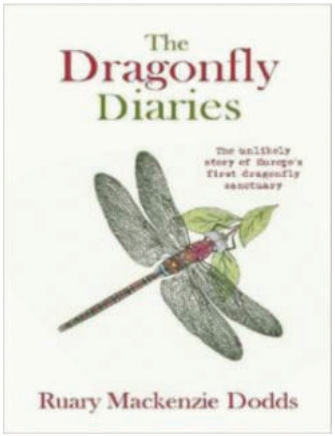
Ruary Mackenzie Dodds

2014. Saraband, Glasgow. rrp £12.99, paperback. pp. 256. ISBN: 1908643552.

Dragonflight: In Search of Britain's Dragonflies and Damselflies

Marianne Taylor

2013. Bloomsbury, London. rrp £13.59, Hardcover. pp. 256. ISBN: 1408164868



The last couple of years have seen the flowering of a genre of natural history book that is autobiographical and taxonomically focused. These books contain personal recollections about particular species or groups of species, and they describe what it was like for the author to encounter them in the wild, and also try to convey the fascination and value of such organisms. At a time when fewer people grow up with experiences of a range of wild species, these books are a welcome way for adults to reconnect with nature and perhaps also encourage young people to follow suit. Most of them also illustrate well the plight of biodiversity in the modern UK countryside.

Perhaps surprisingly, for books appealing to a popular audience, insects feature strongly in this recent flowering of the genre: there is Dave Goulson's *A Sting in the Tale* and *A Buzz in the Meadow*, on bumblebees, and Patrick Barkham's excellent *The Butterfly Isles*. Add to these now, two books devoted to Odonata.

In *The Dragonfly Diaries*, Ruary Mackenzie Dodds describes his experiences over nearly thirty years from a high-pressure job in the city, through his conversion to "dragonfly geek", and his efforts to teach a wider audience about the wonders of Odonata. RES members will be interested that the story involves former RES president Miriam Rothschild. It starts in 1985: Ruary has hooked up with Miriam's niece Kari de Koenigswater, then a colleague at the same firm in London. Seeking some fresh air by the Grand Union Canal at Denham, Ruary is looking for arty things to to photograph, when a dragonfly lands on his shirt. The trail leads to encounters with Miriam at her country house at Ashton in Northamptonshire, and the restoration of a degraded lake to create Europe's first sanctuary dedicated to Odonata, Ashton Water.

Along the way, Ruary gets a sabbatical from work, and then finally quits his city job to run the Sanctuary, and set up what he hopes will be a more visitor-friendly base at Ashton Mill, creating The National Dragonfly Museum, later renamed "Biomuseum". Tragedy later strikes through the termination of the museum lease. The considerable team of volunteers, which seems miraculously to materialize around Ruary whenever he needs some, like a swarm of Fairy Godpersons, simply ups-wings and relocates first to Wood Walton Fen, and later to Wicken Fen (both Rothschild gifts to the nation), where they create the Dragonfly Centre. The Centre is still run as a joint venture between the National Trust and the British Dragonfly Society.

Before evaluating the book further, I must confess a vested interest. In 1990 I helped Ruary for a month setting up Ashton Water Sanctuary during my first summer as an undergraduate. As a result I witnessed first hand some of the bizarre events of the book, and you can find brief mentions of me in the early part of it. This time comes across as immensely rewarding, a great deal of effort, and full of triumphs and disasters, and that is also how I remember it.

There are many amusing incidents involving the different characters that Ruary encounters, not least of whom is the eccentric Miriam herself, and her retinue of high-powered but somewhat dysfunctional academic visitors (yes, that's us, RES Members and Fellows). The mix of intellect, quirky offbeat characters, inherited wealth and good living, combined with a shared passion for the natural world infuses this section of the book. In a curious way that is slightly unsettling, it is irresistible, and immensely warming. In the later part of the book, when Ruary spends less and less time at the house with Miriam, it becomes apparent that life is slightly less rich and, yes, less fun. The characters at the house are replaced by team of volunteers and helpers at the Museum, and also the old Mill and farm machinery, themselves full of character, which are restored to working order by yet more mysterious Fairy Godpersons, who turn up out of thin air and just do it all for free. There's a tremendous can-do spirit about Ruary that made everything happen, and this combined with Miriam in a vital way: because she shared the raw passion for nature, but also had the resources and connections necessary to start it all going. The legacy was rich: two of the volunteers are now officers and trustees of the British Dragonfly Society, hundreds of people were trained to identify dragonfly larvae, tens of thousands experienced the thrill of watching and conserving dragonflies under Ruary's wing, and probably millions have seen Ruary ooze pleasure over Odonata on BBC's *Springwatch*.

The book is smartly produced, with a lovely grey cover and the large (and to me familiar) project logo of a Migrant Hawker, and I particularly liked the attention to detail: the diary date headings, for example, are in large Courier Type, resembling the old typewriter keys that people

still worked with in the 80s and early 90s. That font fits just perfectly. For me the best bits of writing are when Ruary is on his own watching the wildlife move around him, taking in the still of the evening. He has a lovely turn of phrase and the reader is right there with him, absorbing the magic.

There is little to criticise here. The story does lose momentum and humour a little in the second half, as the early hectic days give way to the more routine work of simply running the Sanctuary and Museum, but it maintains enough to keep the reader going. Not all of the colour photos are of particularly high quality, though many are, but they are original to the events depicted. A basic plan of the Sanctuary and Mill would have helped orient the reader when terms like "north bank" and "tea room" are used. The dates needed checking: 30th July 1994 can't be a Saturday if August 3rd 1994 is also a Saturday. I confess as well that, had all the persons involved known that daily records of their behaviour were being kept for future publication, perhaps they would have been a bit more– what is the word – reserved? Then again, possibly not.

Marianne Taylor's *Dragonflight* is a book about her quest to see all the UK Odonata in a single year. In this it replicates the equivalent task set by Patrick Barkham for himself in *The Butterfly Isles*. I read Barkham's book and really loved it, so I knew that to do such a good job with dragonflies instead of butterflies was a tall order.

The first four chapters of the book give novice readers background information on Odonata: their classification and morphology; their life cycle; a short chapter about dragonflies and people; and an introduction to the UK Odonata fauna. The main body of the book describes her encounters with the species she saw, in chronological order. Here we see the format of most of these encounters laid out. Marianne doesn't have a car, and relies on lifts to local sites by willing persons, including her boyfriend Rob. We soon find that photography is what connects these two people, and also that Marianne is basically a birder, who does Odonata as a new side-line. The sites she visits are mostly local to her home in Kent (Dungeness, Tunbridge Wells, Tonbridge, Sevenoaks), and she does a lot of what birders do: following Internet Forums to see where the recent sightings are. Notable birds make a frequent appearance in the Odonata forays. The forays out of Kent include Reading to see Clubtails, the Scottish Highlands for the northern species, Thursley Common in Surrey for heathland specialists, and Broadland, along with unsuccessful trips to the New Forest for a couple of rarer residents, and Rainham Marshes for a rarer migrant. There are follow up chapters on the species Marianne didn't see, and on how she takes her photos of them.

The photos are probably the highlight of the book; Marianne takes a mean shot. Novices will find the introductory chapters useful, and for people in the South-East of England who are thinking of doing something similar, the sites visited will give a useful hint of where to go locally. Marianne writes as if in the company of other like-minded friends with whom she is relaxed and comfortable. This style is likely to appeal to a people who want to try a new outdoorsy hobby, but might lack a bit of confidence or know-how. Readers will be encouraged to use the internet as a way of finding their own way around the Odonata world local to them.

However, I have to admit that this book was, overall, not to my taste. The many positive reviews on Amazon tell me that I may be a statistical outlier here. I didn't like it because of all the things about Barkham's equivalent book about butterflies that did appeal to me, but were absent from *Dragonflight*. Those properties were: obsession with completing a very difficult task and the single-mindedness to try at all costs to succeed; success in completing the task and, along the way, an honest human story about how it changed the writer; a great travelogue that emerged from visiting a host of different places all over the UK; the integration of the biology and conservation issues with the encounters with the species; the journalistic element of meetings with scientists and experts at the sharp end of conservation. Barkham's book is a terrific mash of human story, adventure, agony, ecstasy, environmental reporting, travelogue, and a deep, deep love of his target species. I didn't get most of that with *Dragonflight*, and I missed it.

It would be impressive if someone managed Marianne's task without a car, but I wouldn't be surprised if the quest was unsuccessful. And for Marianne, it wasn't. Not only does Taylor not see all the species in one year, she also doesn't even see them in two years. Not only that, but she also doesn't track down some species that are really not hard to find if you have a car (!!!), know where to go and when to go there. Missed resident species include the Southern Damselfly, the Scarce Blue-tail, and the Irish Damselfly. Excuses are given at the end for these omissions, and some less important migrants that were not spotted. I understand why and how this happened, but I did end up thinking that this was the wrong person for this task. Some of the excuses upset me more than the mission failure itself; for example she doesn't try to hunt Irish damselflies because it's a long way to go, and the species looks pretty similar to some other species. It just seems like the wrong attitude for a task like the one she set herself.

As a travelogue, I think the book also falls somewhat short. Marianne does well enough at describing the places she does visit, but there is too much Kent here and not enough effort to embrace the rest of the UK. *Dragonflight* isn't even very good as an autobiographical account. Marianne has her hobby, and she has fun with it. I just don't see why I should care about that. I don't see how it changes her, makes her a better person, teaches her new things, or brings her meaning in her life. This bites at me because I know that dragonflies can change people, make people better, teach them new things and bring meaning to their lives.

If you want to understand how love of Odonata can change your life and make the world better, go buy *The Dragonfly Diaries*. If you want to read about what it is like to try a dragonfly hobby, *Dragonflight* might be for you, but if you, like me, are hoping to get what you get from Barkham's *The Butterfly Isles*, you will probably be disappointed.

Peter Mayhew,
University of York

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

2015

May 26 **Joint Meeting of the Insect Ecology & Insect Conservation Special Interest Groups**
"*Ant Ecology & Conservation*"
Venue: Rothamsted Research
Convenor: Dr Jenni Stockan (jenni.stockan@hutton.ac.uk)
Confirmed speakers:
Prof. Francis Ratnieks
Prof. Lotta Sundström

June 3 **RES Annual General Meeting**
Venue: The Mansion House, St Albans

June 20 **North Region meeting with the Natural History Society of Northumbria**
"*Bugs and Botany*"
Venue: Cockle Park Science Centre, Morpeth (Newcastle University)
Convenor: Gordon Port (Gordon.Port@ncl.ac.uk)

July 4-5 **Insect Festival (July 5th 10:00-16:00)**
Venue: Yorkshire Museum and Gardens, York
Convenors: Dr Gordon Port (gordon.port@newcastle.ac.uk),
Dr Luke Tilley (luke@royensoc.co.uk),
Mr Peter Smithers (P.Smithers@Plymouth.ac.uk)
The aim of the Insect Festival is to raise public awareness of insects and entomology, a great opportunity for young and old to discover the fascinating world of insects.

Sept 2-4 **Ento' 15 Annual Science Meeting and International Symposium**
"Insect Ecosystem Services"
Venue: Trinity College Dublin
Convenors: Drs Jane Stout, Olaf Schmidt, Archie K. Murchie, Catherine Bertrand, Stephen Jess, Brian Nelson
Registration now open: www.royensoc.co.uk
Speakers confirmed to date:
Janne Bengtsson (Uppsala, Sweden)
Sarah Beynon (Pembrokeshire)
Jerry Cross (East Malling)
Tom Bolger (Dublin)
Dave Goulson (Sussex)
Alexandra-Maria Klein (Freiburg, Germany)
Simon Leather (Harper-Adams)
Craig Macadam (Buglife, Stirling)
Sarina Macfadyen (CSIRO, Australia)
Lynn Dicks (University of Cambridge, UK)
Charles Midega (ICIPE, Kenya)
Michael D. Ulyshen (USDA – Forest Service, USA)

Nov 5-6 **Aphid SIG – French Aphid Research Network Joint Meeting**
Venue: Société Nationale d'Horticulture de France, Paris
Convenor: Jean-Christophe Simon
The French Aphid Research Network (BAPOA, for Biologie Adaptative des Pucerons et des Organismes Associés, https://www6.inra.fr/encyclopedie-pucerons/Pucerons-et-recherche/Reseau-BAPOA) supported by INRA (French Agriculture Research Institute) and the Aphid Special Interest Group of the Royal Entomological Society (http://www.royensoc.co.uk/sig/aphids.htm) are pleased to invite you to a joint meeting on aphids in Paris, November 5-6, 2015 in the conference room of Société Nationale d'Horticulture de France (84 Rue de Grenelle, 75007 Paris, http://www.snhf.org/location-de-salle.html).
These two days are a unique opportunity to share our works on aphids from either side of the Channel, in a friendly atmosphere and a pleasant place in the heart of Paris (next to the Eiffel Tower). Registration will be free of charge, but we will ask you to pay for accommodation and dinner. More details about the programme and the organization will be available in due course.

Nov 12 **Scottish Regional Meeting**
"Soil Entomology"
Venue: St Mungo Museum, Castle Street, Glasgow
Convenor: Dr Jenni Stockan (jenni.stockan@hutton.ac.uk)
Offers of talks in all areas of soil entomology are welcome.

2016

Sep 5-8 **Ento' 16 Annual Science Meeting**
Venue: Harper Adams University College, Shropshire
Convenor: Prof. Simon Leather

Other Meetings

2015

May 31 - Jun 5 **XIV International Conference on Ephemeroptera and XVIII International Symposia on Plecoptera**
Venue: The James Hutton Institute, Aberdeen
Convenors: Craig Macadam (craig.macadam@buglife.org.uk), Dr Jenni Stockan (jenni.stockan@hutton.ac.uk)
Keynote speakers: Dr Ben Price, Prof. Steve Ormerod, Dr William Darwall, Robert Boyle
See http://www.hutton.ac.uk/events/international-conference-ephemeroptera-and-plecoptera for more details

June 12 **Introduction to Beetles**
Venue: Bardon Mill Village Hall
For details and to book www.nwt.org.uk/whats-on or 0191 284 6884.

June 20 **Glow Worms at Thrislington, Sedgefield**
Venue: Thrislington National Nature Reserve, Co. Durham
Convenors: Natural History Society of Northumbria in partnership with ERIC & Natural England
Transport will be provided from the Great North Museum: Hancock and back again. Free but booking is essential on 0191 208 5158 or at www.ericnortheast.org.uk/news-events

June 25 **Small Pearl-bordered Fritillaries at Waskerley, Co. Durham**
Venue: Waskerley, Co. Durham
Convenor: Natural History Society of Northumbria
Free but booking is essential on 0191 208 5158.

June 27 **Bee workshop**
Venue: Cockle Park Science Centre, Morpeth
Convenor: Natural History Society of Northumbria
Free but booking is essential on 0191 208 5158.

July 4 **Butterflies at Bishop Middleham Quarry**
Venue: Bishop Middleham, Co. Durham
Convenor: Natural History Society of Northumbria
Free but booking is essential on 0191 208 5158.

July 9 **North East Wildlife Photography Awards 2015 & George McGavin**
Venue: Great North Museum: Hancock, Newcastle upon Tyne
Convenor: Natural History Society of Northumbria

July 26 **Warden-led Butterfly walk**
Venue: Weetslade Country Park, Northumberland; 11:30am – 2:30pm
For details and to book www.nwt.org.uk/whats-on or 0191 284 6884.

July 31 **Introduction to Bugs, *Hemiptera***
Venue: Gosforth, Newcastle upon Tyne
For details and to book www.nwt.org.uk/whats-on or 0191 284 6884.

Aug 1 **Introduction to Bugs, *Hemiptera***
Venue: Bardon Mill Village Hall
For details and to book www.nwt.org.uk/whats-on or 0191 284 6884.

Aug 1 **Hoverfly workshop**
Venue: Cockle Park Science Centre, Morpeth
Convenor: Natural History Society of Northumbria
Free but booking is essential on 0191 208 5158.

Aug 8 **Purple Hairstreak spotting at Gosforth Nature Reserve**
Venue: Gosforth Park Nature Reserve, Newcastle upon Tyne; 4pm - 5pm
Convenor: Natural History Society of Northumbria

Aug 12 **Moths at Gosforth Nature Reserve**
Venue: Gosforth Park Nature Reserve, Newcastle upon Tyne; 8:45pm – 10:15pm
Convenor: Natural History Society of Northumbria

Aug 15 **Insect workshop**
Venue: Cockle Park Science Centre, Morpeth, 10am – 4pm
Convenor: Natural History Society of Northumbria
Free but booking is essential on 0191 208 5158.

Aug 25 **Surveying bees of Northumberland**
Venue: Gosforth, Newcastle upon Tyne
For details and to book www.nwt.org.uk/whats-on or 0191 284 6884.

Aug 27 **Introduction to Ladybirds**
Venue: Great North Museum: Hancock, Newcastle upon Tyne; 11:30am – 1pm
Convenor: Natural History Society of Northumbria

Aug 29-30 **Shieldbugs, Ladybirds and Grasshoppers workshop with Steve Hewitt (North Pennines AONB Partnership)**
Venue: RSPB Geltsdale, Brampton. Cumbria; 10am – 4pm
Free but booking is essential on 01388 528801.

Sept 7-9 **International Symposium on Biopesticides – Innovative technologies and strategies for pest control**
Venue: Swansea University, Swansea
Convenor: Tariq M. Butt
See:http://www.swansea.ac.uk/biosci/researchgroups/snapandbanpgroup/biocontrolandnaturalproductsbanp/symposiuminfo

2018

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

author guidelines

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

AIMS AND SCOPE

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

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

READERSHIP

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

INSTRUCTIONS FOR AUTHORS

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

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

PAGE CHARGES

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

REVIEW AND PUBLICATION PROCESS

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

SUBMISSION PROCESS

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

EDITORIAL BOARD

Royal Entomological Society

The Society's Offices

- The Mansion House is open to members Monday to Friday between 9.30 am and 4.00 pm
- The General Office is open for enquiries and sale of publications

The Library

- The Society possesses one of the finest entomological libraries in the world, which is open to the membership
- A loan and photocopying service is available to the membership
- The Library is open on all weekdays for private study and research by arrangement with the librarian

Activities of the Society

- Frequent one-day workshops organised by the Society's Special Interest Groups
- National Science Meeting annually – with a specialist international Symposium biennially
- Regional activities in all parts of the United Kingdom
- Postgraduate Forum
- *Antenna* – the house journal of the Society, sent free to the membership
- Each year the Society gives the Marsh Insect Conservation Award (prize £1,000), and other Awards (see website)
- In 2004 the Society launched 'National Insect Week' which is now a biennial event (see www.nationalinsectweek.co.uk)
- In 2007 the Society launched the 'Wallace' Award for Postgraduates
- Biennial Insect Festival

Publications

- The Society publishes seven internationally recognised scientific journals:

  Ecological Entomology
  Agricultural and Forest Entomology
  Physiological Entomology
  Systematic Entomology
  Medical and Veterinary Entomology
  Insect Molecular Biology
  Insect Conservation and Diversity

- Each year three of the journals will select the best paper that they have published over a two year period to receive a Society Academic Award, presented by the President of the Society.
- The Society's house journal *Antenna* contains reports on all Society Meetings and other activities; there are also articles, readers' correspondence and a Diary Section. *Antenna* also contains a Postgraduate Student section.
- *The Handbooks for the Identification of British Insects* is a continuing series of important works.
- The highly successful *Symposia Volumes* are published biennially following each Symposium.
- In 2008 the Society launched a new academic Journal *Insect Conservation and Diversity*

Royal Entomological Society
www.royensoc.co.uk
The Mansion House, Chiswell Green Lane,
St. Albans, Herts, AL2 3NS, UK
Tel: +44 (0)1727 899387 • Fax: +44 (0)1727 894797
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Please send information about RES activities in the United Kingdom Regions (please tick):

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Northern Ireland ☐ Scotland ☐

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Royal Entomological Society
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Royal Entomological Society

The Royal Entomological Society exists to promote the dissemination of knowledge in all fields of insect science, and to facilitate communication between entomologists, both nationally and internationally. It is the principal society in the United Kingdom for professional entomologists, and also has many overseas members, as well as a strong amateur membership.

History of the Society

The Royal Entomological Society was founded in 1833 as the Entomological Society of London, and granted its royal charter by Queen Victoria in 1885. In 1920 the Society moved to its previous address at 41 Queen's Gate and in 1933 King George V granted the right to add the word 'Royal' to the title. Many eminent scientists of the past, Darwin and Wallace to mention but two, have been Fellows of the Society. Through the years most internationally recognised entomologists have been, and are, numbered among the Fellowship. In 2007 the Society moved to more spacious premises in St. Albans.

Membership of the Society

The Society comprises Fellows and Members:

Fellowship is open to entomologists who have made a significant contribution to their science, through publications or other evidence of achievement. Fellows are entitled to make use of the title *Fellow of the Royal Entomological Society (F. R. E. S.)*.

Membership is open to all who have a genuine interest and enthusiasm in entomology. Membership does not require academic qualifications. Members are now entitled to use the suffix *Mem.R.E.S.*, not applicable for students.

APPLICATION FOR MEMBERSHIP

If you wish to apply to become a Member of the Royal Entomological Society, please fill in this form, detach it and send it to the Registrar (address overleaf).

Applicants for Membership should also complete the section on Methods of Payment. Any person wishing to apply for Fellowship should complete the separate Fellowship application.

Surname: _____

First names: _____

Title: Mr/Mrs/Miss/Ms/Dr
Other (please specify) _____

Address: _____

_____

_____

_____

Postcode _____

Telephone no: _____

Fax no: _____

Email address: _____

_____

Date of Birth: _____

Gender M/F: _____

Degree details (BSc, PhD etc) if applicable: _____

_____

Course Termination Date: _____

Please register me for information about Entomological Special Interest Groups (please tick):

Aphids	☐	Aquatic	☐
Behaviour	☐	Climate Change	☐
Conservation	☐	Ecology	☐
Endosymbionts	☐	Infection & Immunity	☐
Medical & Veterinary	☐	Orthopteroids	☐
Parasitoids	☐	Pollination	☐
Post-Grad. Forum	☐	Post Harvest	☐
Sustainable Agriculture	☐		

form continues overleaf...