Scale insects – the Coccoidea, a superfamily in Hemiptera – in many respects are most unusual insects. Sexual dimorphism is extreme (see Figure 1). Males are relatively conventional, being winged and flying, albeit erratically, with a single pair of wings and haltere-like structures that have them misplaced in Diptera accessions even by trained entomologists. Female adults are reduced in external morphology, flightless, more or less globular to ovoid, without an evidently delimited head, thorax or abdomen, and are sessile and sedentary. Weirdness includes life-cycles that lead to the dimorphic adults: 'prepupal' and 'pupal' stages occur in the (non-'holometabolous') male development, but no such stages exist in the female which undergoes one or two fewer mouls than the male (depending on taxon), directly from nymph to the 'nymph-like' female adult. Not all coccoids follow this path, however, with males eliminated or present only sporadically in many species. The curious genetics (including extraordinary karyotype diversity and genomic conflicts) exhibited by these insects are subject to much contemporary study. Most curious is the system in Icerya purchasi (the cottony cushion scale, Figure 2) which Laura Ross (University of Edinburgh) and colleagues term androdioecy (the coexistence of males and hermaphrodites) – the only such case known in insects. Parthenogenesis in scale insects seems to encourage dispersivity. With nymphs and adult females feeding on phloem, many mealybugs, soft scales and armoured scales have become globalised plant and crop pests, whose control by chemicals, pheromones and natural enemies is a major research area.

Ecologically, coccoids are known for both narrow host-specificity and for...
extreme polyphagy. Being mostly phloem feeders (the major exception is Diaspididae), their plant-sourced diet is low in protein but rich in sugars with the excess usually eliminated as honeydew. This important natural resource provides carbohydrate provisioning, notably for the many ants which tend (perhaps even ‘farm’) scale insects. Scale insects are veritable chemical factories, producing crimson pigments either derived from Kermes, favoured by Mediterranean peoples as one of the oldest organic dyes, or in the form of carmine dye (cochineal), used by Aztecs and Mayans in Central and South America. These ‘natural’ red colours continue to be used in the food industry, but sadly no longer in the aperitif Campari. Other coccoid-produced chemicals include an extraordinary range of waxes from diverse cuticular glands, and some used by humans include lac and shellac.

Given such a range of biological important phenomena exemplified within the superfamily, it may come as a surprise that researchers on these insects can find enough coherence to meet every three years to discuss their studies. Actually, thirteen International Symposia on Scale Insect Studies (ISSIS) have now taken place, with the most recent held in Sofia, Bulgaria, in September, 2013. This was organised by Katia and Georgi Trencheva of the nearby Bulgarian University of Forestry, with Vladimir Alexziev skillfully managing the audiovisuals. Papers and posters presented by over seventy participants covered all the areas of coccoid studies mentioned above, and more.

The Royal Entomological Society has had a long association with scale insect studies, most notably in publishing papers on the taxonomy and systematics of the group. Therefore, to coincide with the Sofia meeting, *Systematic Entomology* editor Peter Cranston, our society and Wiley publishers assembled a virtual issue on Scale Insect studies. For those who have missed out on the phenomenon, virtual issues bring together a dozen or so previously published papers covering a particular topic, making them available electronically with free unrestricted access. Eight thematic virtual issues have been compiled for *Systematic Entomology* over the past five years, associated often with gatherings such as the Entomological Society of America and International Congress of Entomology. Nate Hardy, now of

Figure 3. Best young researcher awardees, left to right: Bora Kaydan (2010), Nate Hardy (2013) and Demian Kondo (2007). Far right. Peter Cranston. Photograph: P.J. Gullan.
Auburn University, Alabama, introduced the issue with a review on the status and future of scale insect (Coccoideae) systematics. With Chris Hodgson, he also authored one of two newly published articles, concerning the value of the rather neglected male scale insects in phylogeny. The twelve other articles range from excellent alpha-taxonomic work to state-of-the-science molecular studies. Some studies highlight the difficulties in reconstructing evolutionary relationships for insects with seriously limited morphology, and illuminate the insights that can come from molecular phylogenetics. Nate’s published review, also presented orally to the meeting, provided guidance to maintaining the balance between classical morphological and molecular work and the developing field of transcriptomics, with its potential to provide massive amounts of data and resolve some of the most difficult (deep) relationships in the Coccoideae.

Evidence for the value of a robust estimate of the evolution of the scale insects came in many talks in Sofia, including those concerning relationships with ants, understanding the role of karyotypic evolution in cryptic species formation, in the distribution of paternal genome elimination and hermaphroditism, in interpreting host plant and endosymbiotic evolution, and in recognising ancient radiations associated with host plants. These evolutionary studies came from several labs, notably those of Lyn Cook (University of Queensland, Brisbane, Australia), Ben Normark (University of Massachusetts, Amherst, USA) and geographically dispersed ex-members of Penny Gullan’s lab (formerly University of California, Davis, now retired to Canberra). Molecular approaches were evident also in many studies seeking to understand the species limits of certain pest taxa, and their dispersal pathways to becoming nuisances outside of inferred native ranges.

I am surely not the only entomologist wondering which currently obscure species (or complex of species) will evade quarantine and become the next invader of our crops, horticulture or ornamental plant nurseries. But will there remain enough taxonomic expertise to recognise the species when the inevitable happens? As the meeting drew to a close, Maurice Jansen, whose position with the Netherlands Government is at the ‘coal face’ of quarantine intercepts and identification, drew our attention to the precarious position of the taxonomic workforce, challenging our abilities to recognise and act on incursions, and to do the necessary systematic research to support biosecurity. Nate Hardy addressed this issue in his review – everyone is having to do more (globalisation), with less resources (funding cuts). It seems extraordinary that the two institutions with the longest traditions, largest collections and greatest responsibilities, lack expertise dedicated to the group; thus Dug Miller has not been replaced at USDA in Beltsville, and the Natural History Museum, London, erstwhile home of Douglas Williams and Jon Martin, similarly lacks a specialist since their retirements. How can biocontrol succeed without professional expertise in the host insects? We know the answer of course, with past costly programmes threatened or invalidated by inadequate taxonomy. Must it take another cassava mealybug to expose that our reliance on an ageing cadre of retirees and naive biocontrol amateurs is not the way to go?

A likeable aspect of the ISSIS are the awards and recognition given to young researchers and more senior practitioners, plus obituaries prepared for those deceased since the previous meeting. The latter were the prolific and internationally respected Hungarian coccidologist Ferenc Kozár and the highly productive Rosa Henderson from the New Zealand Arthropod Collection. Tributes were given to senior colleagues Jan Gilioeme (South Africa), Daniele Matile-Ferrero (France) and Imre Foldi (Hungary-France). The best young researcher award went to Nate Hardy, following previous winners Bora Caydan (from Turkey) and Demian (Takumasa Kondo (from Colombia). The three are pictured (Figure 3) along with your reporter at a traditional Bulgarian social dinner, with rakija.

As a non-specialist attending as an ‘accompanying person’ I was most impressed by the collegiality of the group and ongoing interchange and collaborations of researchers. This cannot be said for all such meetings, whether taxon- or topic-based. The location in Bulgaria gave two attendees in particular (myself and Chris Hodgson), along with some colleagues, the chance to see a pair of wall creepers (Tichodroma muraria) in Trigrad Gorge in the scenic Rhodopi Mountains. Previously and elsewhere, this beautiful bird had eluded Chris and I for a combined total of over a century.

The next ISSIS meeting will be hosted by Agatino Russo and colleagues in Catania, Sicily, in 2016. I eagerly await further insights into the evolution of this extraordinary group, and hope to hear of an expansion of professional expertise to cover the inevitable new incursions.