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This month's member spotlight is our journal editor Dr Robin Gunning. For most of her career Robin was based in DPI Tamworth where she specialized in insect resistance, amongst other endeavours, and remains a world expert in the management of insect resistance.

This month we also publish the four submissions for the inaugural Ted Taylor prize, won by Joshua Whitehead from University of New England on the relationship between mirid bugs and carnivorous plants. Joshua has received the $1000 prize and all participants have been given free membership to the society for 2021.

Recently, many of you may have read that Geoff Monteith, a Queensland based member of our society, was named among the top ten scientists as measured by the number species named after him – in the same league as Charles Darwin. A quick scout of our other members revealed some others that have also been honoured. Happy reading.

This month, in the Photo Corner section, there is a feature on cossid moths generated by the interest of young member Ambrose with some fantastic photos.

We continue providing hyperlinks to entomological stories and research that may be of interest to members.

Kind Regards

Garry Webb

Circular editor

Member Spotlight

DR. ROBIN GUNNING

I'd always been one of those kids who was fascinated by the natural world but never dreamt it could become my career. However, whilst doing an Arts degree at the University of NSW I found that the compulsory science subjects (biology and invertebrates) were far more interesting than the history and political science I was meant to be studying. I had discovered the insidious charm of insects and resolved to make entomology my career. So, after graduating with that BA, I took a job as a technical assistant in the analytical chemistry section at the Australian Atomic Energy Commission and studied part time for a science degree at the University of NSW, majoring in chemistry and entomology. My entomology studies were with Dr Erik Shipp. I went on to graduate with Honours Class 1 in Entomology.

Having picked up a Commonwealth Postgraduate Research Award, I quit my job and enrolled in a PhD in entomology at the University if NSW with Erik Shipp as my supervisor. I'd always had a physiological bent, so the title of my thesis was "A Circadian rhythm in the Eye Nerve Activity from the Housefly, *Musca domestica*". Doing a PhD at the Randwick entomology labs in the company of entomology staff and students was tremendous fun and I made friends for life.

At the end of my PhD, I was astounded to receive a job offer from the NSW Department of Agriculture as Entomologist based at the Tamworth Agricultural Research Centre and I thought I'd better take it. Here I found a background in chemistry as well as entomology was very useful. I became a specialist in insecticide resistance and the chemical control of insect pests in field and horticultural crops. In particular, I worked on the control of *Helicoverpa* spp. and *Bemisia tabaci* on cotton. I published extensively in the areas of insecticide bioassay, insecticide application, synthetic and biological insecticides, insecticide resistance management and in the mechanisms of insecticide resistance. I am a world authority on the management of insecticide resistance. Of particular interest to me was my long-standing collaboration with Dr Graham Moores of Rothamsted Research in the UK, involving biochemical mechanisms of insecticide resistance and the binding of insecticides and insecticidal proteins, such as Bt, to esterase isoenzymes. My research resulted over 50 refereed publications and two international patents. I supervised some 10 higher degree students in entomology. I retired from the Department of Primary Industries in 2015 as Principal Research Scientist and I remain grateful to those bosses who saw the value of research and encouraged me.

I have other interests in entomology as well. For a time, I was convenor of the Australian Entomological Society's Conservation Committee. I was a member on the NSW Scientific Committee, (convened under the Threatened Species Act, 1995) from 1996-2003, which was a most rewarding experience. I'm also Editor of *General and Applied Entomology* which is the journal of the Entomological Society of NSW. It is a real privilege to assist authors in the publication process.

Ted Taylor Entrants

The relationship between mirid bugs and carnivorous plant species – Is it parasitic, commensal, or mutualistic?

Joshua Whitehead
University of New England
Armidale

Abstract:
An unknown number of species of Hemipterans (true bugs) in the tribe Dicyphini (Miridae) have been found to live in close association with carnivorous and protocarnivorous plant species. However, the nature of these relationships has been difficult to determine, often as a result of contradictory behaviours and perceived impacts. Here I discuss the impacts of known carnivorous plant-bug interactions to determine whether they are parasitic, commensal, or mutualistic in nature.

Introduction:
Mirid bugs (Miridae: Hemiptera) are a speciose group of insects known as 'true bugs' (Heteroptera) that use piercing mouthparts to extract nutrients from plants and other insects. Most widely known species are considered pests in agriculture (e.g. *Lygus hesperus*) whose feeding habits cause significant damage and spread viral plant diseases. However, a few species are mostly predatory and are valued as biocontrol agents (e.g. *Dicyphus hesperus*), despite being omnivores that will die when deprived of their host plants (Gillespie and Mcgregor 2000). This omnivorous feeding behaviour may have prompted some groups in tribe Dicyphini (*Pameridea* and *Setocoris* spp.) to evolve in close association with carnivorous host plants. For today there are a number of Dicyphini specialised for life on carnivorous plant species (e.g. *Byblis*, *Drosera*, *Roridula*, and *Stylidium* spp.).

Known only from the Western Cape province of South Africa and Australia, these bugs are extremely well adapted to living on sticky surfaces, and therefore able to negotiate their way through the sticky secretions of their host plants. This enables them to feed on the other insects caught by their host plant, in a behaviour that is often called as kleptoparasitism (parasitism by theft). However, the nature of this symbiosis becomes considerably more complex when you consider that such behaviours may help the host plant. For instance, by reducing the number of prey items, the bugs can prevent plants being overburdened, which can lead to a nutrient overload and die-back in carnivorous plant species. Meanwhile, in protocarnivorous plant species like *Roridula* and *Stylidium*, the bugs are more likely to be commensal (benefiting without affecting the host plant) or beneficial (mutualistic). Since these protocarnivorous plant species lack the enzymes to digest insects, meaning they derive no direct nutritional benefit from trapping insects. Here I'll discuss the behaviour and likely impacts of two mirid bug genera (*Pameridea* and *Setocoris*) that are known to live in close association with insect trapping host plants, with the ultimate aim of determining whether they're parasitic, commensal, or mutualistic on their chosen host plants.

***Pameridea*:**
Pameridea is a genus of two described bug species (*P. marlothii* and *P. roridulae*) that live in close association with plants in the genus *Roridula*. *Pameridea marlothii* occurs exclusively on *R. dentata*, while *P. roridulae* has a facultative (non-exclusive) preference for *R. gorgonias*. Endemic to the

western cape of South Africa, both species feed on insects caught by the host plants, which possess leaves that are covered in sticky resin-tipped trichomes (hairs). If there is an absence of insect prey, *Pameridea* will often feed on the host plant, avoiding capture with specialised feet and a thick, waxy epicuticle (Voigt and S. 2008). Females lay eggs directly into the tissues of a host plant, and in the absence of a host *Pameridea* enter diapause (dormancy) or die of starvation. This implies that *Pameridea* may be wholly dependent on the host plants (obligate symbionts), and maybe a risk of co-extinction in their absence.

Initially thought to be parasites, several nitrogen tracing experiments have shown that *Roridula* may be unable to digest insects (Ellis and Midgley 1996). This suggested the relationship with *Pameridea* may be commensal (neutral), as initial observations implied that *Pameridea* may pollinate *Roridula* (Ellis and Midgley 1996). However, like most carnivorous plant species, *Roridula* have a poorly developed root system and grow in heavily leached acidic soils in wet conditions. They also possess leaves that strongly absorb the primary wavelengths of ultra-violet (UV) light, which are assumed to attractant to flying insects to carnivorous plant species. It has been therefore suggested that *Roridula* still benefits from trapping insects, despite an inability to extract nutrients from them. Instead, subsequent tracing experiments using the rare isotope nitrogen-15 have shown that *Roridula* can absorb nutrients from *Pameridea* faeces (Ellis and Midgley 1996). Meaning that the bugs serve as a surrogate in digestion of captured insects, removing carbohydrates and proteins, and leaving nitrates. Resulting in a mutually beneficial arrangement for both plant and insect species, since the carbohydrates and proteins are of no use to *Roridula*.

***Setocoris*:**
Setocoris is a genus of three described mirid species (*S. bybliphilus*, *S. droserae*, and *S. russelli*) that are known to occur on plants in the genera *Byblis*, *Drosera*, and *Stylidium*. Currently they are endemic to all states and territories of Australia, though there are numerous colour morphs and potential variants that await description. All *Setocoris* species feed on insects caught by their host plants and like *Pameridea*, will feed on the host when these are absent. Unlike *Pameridea*, these hosts often secrete their own digestive enzymes (e.g. *Byblis* and *Drosera*), and therefore don't need *Setocoris* bugs to digest trapped insects for them. This means their interactions are less clearly mutualistic. Even in the few cases where their host plant may lack digestive enzymes (e.g. *Stylidium*).
Interactions with Stylidium:

In the south-west of Western Australia, *Setocoris* may occur on *Stylidium* species (Nge and Lambers 2018), though it's unknown whether this occurs elsewhere in Australia. Most *Stylidium* species are considered to be protocarnivorous, since they possess hairs that trap insects, but don't appear to digest them. However, enzyme (proteinase) activity has been found to be triggered on contact with the trap hairs. This suggests that *Stylidium* may absorb nutrients like *Roridula*, though nitrogen tracing experiments have shown no significant benefit from trapping insects (Nge and Lambers 2018). This suggests that *Stylidium* may be entirely non-carnivorous, and therefore likely to be commensal with *Setocoris*. Nevertheless, further study will be needed to confirm the nature of this relationship, as glandular hairs may also serve as a defence against herbivores.

In *Stylidium*, these glandular hairs are concentrated on the flowering stems and reproductive structures, where herbivory is most likely to effect plant fitness. By circumventing these defences *Setocoris* may serve as parasites to Stylidium, as despite their predatory nature most *Setocoris* species are omnivorous. Any resultant herbivory would therefore be at a cost to the Setocoris host plant, if it was not subsequently counterbalanced by other services. For instance, Setocoris may still benefit plants if they prevent more serious herbivory by predating upon other insects that may escape the trap hairs.

Interactions with *Byblis* and *Drosera:*
Byblis and *Drosera* species produce their own digestive enzymes and are therefore able to extract nutrients directly from captured insects. Interactions with *Setocoris* are therefore likely parasitic,

since the plants are losing out on nutrients that are absorbed by the insects. However, since the bugs are removing carbohydrates, proteins and oils of no use to the host plant, while leaving behind the majority of nitrates the plant is looking for. It is likely that the impacts of *Setocoris* feeding on insects has a minor impact on the host plant's overall fitness. Indeed, by removing overabundant prey items, the bugs may prevent host plants from being overburdened, which can lead to nutrient overload and the discard of affected trap leaves. Culminating in a significant waste of resources in lost prey items and leaf structure. Additionally, *Setocoris* may suppress herbivores that pose a much greater risk to their host plant. For instance, by killing and consuming the larvae of *Buckleria* (Lepidoptera: Pterophoridae) moths, which feed on *Drosera* (Osaki and Tagawa 2020).

Conclusion:
The nature interactions between mirid bug and carnivorous plant species appear most often to commensal (neutral), or mutualistic (beneficial). For while the host plants may lose nutrients through mirid bug herbivory and kleptoparasitism, the negative impacts of these losses are likely offset or superseded. This is largely due to benefits provided by pest control, and digestion, as well as the removal of overabundant or undigested prey items. In their absence, it's likely that host plants are subject to more intense rates of herbivory and reduced nutrient uptake efficiency, which may explain why the plants exhibit no defence against their associate species.

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The mysterious tale of a trio: *Wolbachia* bacteria – strepsipteran parasite – tephritid fruit fly host

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What better way to present research to a general public than a creative story?

Bored one evening after the day's escapades, I decided to sit beside my nana as she read one of her books sipping on her favourite fruit juice while watching the sunset. Nana looked relaxed; her red-brown body colour and yellow shoulder pads looked amazing in the evening light. Her outstanding compound eyes were glued to her book and antennae hanging over her face, I watched her for a minute, and I could not stop admiring the beautiful features that brought out the real definition of a tephritid fruit fly, *Bactrocera tryoni*.

Beside us was a pond and I could see another group of our kind swimming, call them the water bugs. Curious as usual, I asked "Nana why are we not able to swim as they do?". Looking straight into my eye, nana placed her hand on my shoulder and said "Good question my child, see, we are not only considered fascinating but also the most successful organisms in the world. We are small in size, but our class is vast and diverse, some of us can fly, walk, jump or even swim. Furthermore, we represent more than half of the living organisms in the world with approximately 6-10 million extant species[1]. We have diverse interactions, for instance, with the other members of our class, some of whom I have never met in my life, plants and even microorganisms that live within us, and that is why I call us the 'The great Insecta'. For instance, we as *Bactrocera tryoni* are known to have interactions with plants, we lay eggs in fruits and therefore considered as pests, we also interact with bacteria that live within us".

Nana handed me a book titled "The mysterious tale of a trio". I am not a fan of books but why not?

The synopsis read "*Wolbachia* are tiny bacteria that have an intriguing interaction with a wide range of insects, they live in insect cells and are known to have an intimate relationship with their hosts[2]. These bacteria are generally passed on by mothers to the future generations, however, their pervasiveness and close genetic relatedness across diverse insects means that horizontal transmission of *Wolbachia* from one host species to another occurs in nature[2]. These tiny bacteria cause a form of reproductive sterility, called cytoplasmic incompatibility to its host and this has been explored as a method to fight pests and disease vectors[2]"

I paused a minute and looked around just to be sure that no one was coming for us, then looked at nana "Do not be scared little one" she said "like I told you, we are the most diverse organisms and no weapon formed against us shall prosper, keep reading"

"In some hosts, these tiny bacteria have been reported to have other unusual characteristics, for instance, lack of clear host effects, variable prevalence across host populations and low-density infections, sometimes of the same type across multiple insect species. These could be attributed to horizontal transmission of *Wolbachia* in insect population. Similarly, these characteristics have also been reported in seven Australian tephritid fruit fly species, including *Bactrocera tryoni*[3]. To further investigate these interactions, researchers looked at the host genome sequences of field-caught *Wolbachia*-infected fruit fly males."

At this point I had to take a moment of silence for our fallen heroes. I always wondered why Nana had a glass of juice with her, this is the kind of stuff she reads. These humans are cruel in the name of science, no wonder our friends the mosquitoes are giving them sleepless nights!

“In addition to the usual fruit fly mitochondrial genomes these researchers unexpectedly found complete mitochondrial genomes of a twisted-wing parasite (Strepsiptera) in the genome libraries, possibly of the previously described *Dipterophagus daci* [4,5], suggesting that the detected *Wolbachia* may be linked to concealed parasitisation of flies by *Dipterophagus daci.* These mitochondrial genomes were analysed and based on their low genetic variation; it was concluded that the flies were parasitised by individuals of one strepsipteran species.”

I was literally on the edge of my seat at this point, I mean what in the world? Parasites again?

“To investigate the link between the tiny bacteria and these concealed parasites, the researchers developed a PCR-based diagnostic tool and tested the presence of the *Dipterophagus daci* parasite in *Wolbachia*-infected and uninfected tephritid fruit flies, and they found that all the flies that were positive for these bacteria were also positive for the parasite. To further confirm these findings, parasitised fruit fly samples were selected based on their visible parasitisation (illustrated in the picture). These samples were dissected, and PCR used to detect the presence of *Wolbachia* in the dissected tissues and *Dipterophagus daci* samples. Results showed that *Dipterophagus daci* samples were positive for *Wolbachia* and had higher *Wolbachia* densities compared to the fruit fly tissues, suggesting that *Wolbachia* is indeed in the *Dipterophagus daci* parasite”

I thought to myself that this was getting interesting and yet was just the synopsis, on second thought, I was going to read the whole book because it is the story of my life.

I looked at Nana and asked, “is this even true or is it fiction?”
Nana sipped on her juice again and said “it is true my child, there are some parasites that can attack us and surprisingly these new findings show that the previously detected *Wolbachia* in Australian tephritid fruit flies could have been due to their detection in a concealed strepsipteran host. These findings corroborate previous studies that have detected *Wolbachia* in other Strepsiptera[5]. It also shows that strepsipteran parasitisation is not always visible and that *Wolbachia* detection in other insects may be due to the presence of undetected strepsipterans.

“Nana, do you know the prevalence of these parasites in our group, and what these tiny bacteria do to the parasites and to us?”

Nana looked at me over the top rim of her eyeglasses and said “I do not have answers to those questions, my child, these current findings form a basis for future research of this fascinating and unexplored three-species interaction, which includes us. I hear the sequel of the book is coming out soon, I cannot wait.”

“Me neither!”

Figure: *Dipterophagus daci* parasitised fruit fly abdomen

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What's *Amata* with these moths?

Georgina Binns, PhD Candidate, Macquarie University

When I first started my research into warning signal variation in the diurnal wasp moth, *Amata nigriceps*, I ran into a barrier of extreme lack of information about this very common species. Looking them up in Australian field guides showed that even experts in the lepidopteran field struggled to correctly identify them and separate them from other *Amata* species, regardless of the fact that they emerge in prolific numbers in summer and autumn along the east coast of Australia. There is no known information on what their host plants are, what environments they inhabit or what their distributional range is- in fact, I could not find any data on their life cycle in any literature anywhere. I found one study on Australian "*Amata spp*." referring to their chemical defence (Rothschild, 1984), but that was the extent of it. I was put in contact with Dr You Ning Su at ANIC, Canberra in 2018, at the very beginning of my Masters research, who in no uncertain terms told me to pick a different species of moth to study. After two years of attempting to curate ANIC's extensive historical *Amata* collection, he threw his hands up at them and told me that no one wants to go anywhere near them, and for good reason- they all look the same. As I descend from a long line of extraordinarily stubborn humans, I decided that these highly regarded entomologists where obviously waiting for me to come along and figure it all out, so I pushed forward on my quest to solve this mysterious *Amata* puzzle- who are they? Why is there no information on their biology or life history? Why do most Australians immediately recognise them as 'tiger moths' and have associated stories about summertime clouds of them, but we don't even know what they eat?

Amata nigriceps are a day-flying aposematic moth from the family Erebidae. They have bright orange spots and stripes against a stark black body and wings which warns potential predators of their possession of a grossly unpalatable chemical defence, expelled in a neck secretion (and possibly other parts of their body). They also have the ability to interfere with microbat echolocation hunting calls by 'clicking' with an organ in their thorax, called a tymbal (for example, Pennay, 2003). These defences are effective at evading or deflecting predation attempts, and possibly explains why they are so common and successful. My research includes questions primarily focused on the observed and quantified variation found in their visual warning signal. We know now that variation in warning signals is a common occurrence in aposematic species, contrary to the hypothesis that these signals should remain consistent and clear in populations for maximum protective effect against predators (Briolat et al., 2018). However, we still do not know why this variation persists, or what causes it. As is common in most ecological and evolutionary questions, there is never a single and satisfying answer, and thus I find myself neck deep in state-wide specimen collection and historical museum collection trips, clay model field experiments to see if predators respond to this variation, and larval-rearing lab experiments to test what effects food and temperature have on signal expression. The benefits of these studies include, that I am collecting solid data on their life history, ecology and distribution, and will add to our collective knowledge of these native insects. So far, I have learned that their spots are getting bigger over time, they fly from October to April and have two generations per year, they over-winter as larvae, and they prefer decaying rose petals over freshly bloomed petals!

As a scientist and sometimes overtly compassionate person, I have become drawn to movements within academia and industry that loudly promote conservation, rally against climate change and the global extinction crisis, and definitively announce grand plans to describe every species in the world. I support these movements because they are important to the planet and all its inhabitants, if only because we, as residents of Earth, owe the planet our very lives. Recently attention has turned to global invertebrate loss, and a short but firm correspondence to the Editor by global scientists to outline a plan for insect conservation and recovery was published that gained much media attention (Harvey et al, 2020). It is an inspiring communication that highlights the need for immediate action, with 'no-regret solutions' and a 'learn by doing' approach, which ensures that even if we make mistakes, at least something is being done. Whilst I agree with this strategy, something about the plan struck me as an oversight. The authors outline a series of steps, with the second being 'Prioritisation'; in this step it is recommended that large-scale invertebrate assessments of the conservation status of insect groups are performed to identify priority species, which of course is logical. However, many Australian species of invertebrate are still undescribed, much less discovered. How do we identify priority species when we don't even know the basic life-history and ecology of some common and prolific species? The sheer amount of personnel, equipment and funds needed to undertake the necessary surveys is enough to make anyone feel overwhelmed by the enormity of this task.

I was fortunate enough to recently be included in a series of roundtables organised by Taxonomy Australia, a group whose mission statement is to identify and describe every species in Australia in a single generation, another task which sounds overwhelming. However, after a few days gathered with other systematists and taxonomists from around the country, their optimistic and enthusiastic ideas made this mission sound more than plausible. As a result, an outline for creating a singular method of listing the world's species was published, which describes issues raised by international taxonomists, such as refining existing species concepts and the methods used to define new species (Garnett et al., 2020). This is not easy, as in the age of environmental DNA collection methods, we can discover the genetic presence of new organisms in the environment without a physical 'body' to describe, such as some newly identified fungi species. Again, I find that by relating this mission to my own research progress, I wonder how we can broaden it by not just including morphological and genetic descriptions, but the biology and ecology of the organisms as well. Can we even effectively conserve a species without knowing its distribution, food of choice, or life history? Do we even have enough scientists in the world to study them all?

My mysterious little *Amata* moths are certainly giving me a run for my money. Not only do we know very little about these cryptic little lepidopterans, but we're not even really sure of their true identity. Since their initial description back in 1876, several attempts have been made to clarify their morphology and identify and distinguish them from their congeneric sister species (who, might I add all look extremely similar and pretty). I have some molecular evidence that my *A. nigriceps* are probably a complex of sub-species, stretched out across their distribution in Australia. This further complicates things. Whilst I suspect they eat leaf-litter and other decaying vegetation as larvae, what if some of them are more fussy feeders in some areas and this is influencing the variation we've seen in their warning signals? Birds don't seem to fancy them here in New South Wales, but what if they are more delicious in Queensland or Victoria? Do they fly around in winter in warmer climates? Where do they acquire their chemical defence from? All the other scientists seem really busy, so I think it's up to me to find the answers.

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<u>**Predation on insects may be higher in cities.**</u>

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Cities are often seen as being artificial environments, devoid of any life except for what people a llow to exist. But a surprising number of plants, animals and other organisms manage to slip through the cracks. These organisms continue to interact with each other in various ways, such as predation, herbivory and pollination. And these interactions can be useful for people: for example, predation can keep pest populations down, reducing the need for people to use pesticides.

But these important interactions may be weakened in cities. One study found that the rate of predation is reduced by one-quarter in cities compared to rural areas (Eotvos et al., 2018). However, most studies of predation have investigated predation on birds, and most have been carried out in North America (Eotvos et al., 2018). To better understand how predation is affected by urbanisation, we need to study it on other types of animals and in other parts of the world.

To fill this research gap, scientists at the University of Sydney measured predation on insects in the northern Sydney region during the winter of 2017. They used two different methods to measure predation.

In the first method, artificial prey were attached to branches of pittosporums (*Pittosporum undulatum*; a common understorey plant in the region), allowing naturally occurring predators to attack them. The artificial prey were made of plasticine and shaped to resemble three types of insects: caterpillars, beetles and planthoppers. After two weeks, the artificial prey were retrieved and the proportion that had attack marks (left by a predator that attempts to feed on the artificial prey) was used as a measure of predation.

In the second method, fly-screen cages were attached to branches of a different set of pittosporums. Each of these cages was filled with a variety of live prey insects (including the three types represented by artificial prey), and half of these cages were also filled with predators (spiders and mantises). The live prey and predators were collected from nearby pittosporums. The cages were retrieved after three weeks, and the difference in prey survival between the predator-present and predator-absent cages was used as a measure of predation.

Why were these two methods used? Well, a range of methods have historically been used for measuring predation. In addition to the two used here, other methods include setting out dead prey, and setting out live-but-immobile prey such as eggs (Nagy et al., 2020). All of these methods have their advantages and disadvantages: live prey may be more realistic, but it's also more difficult to handle live animals than dead (or artificial) ones. This study therefore made use of two methods in order to compare the results between them.

Likewise, multiple different types of prey were used to provide a more comprehensive picture of how urbanisation affects predation. Different types of insects vary in how vulnerable they are to predation, and are attacked by different types of predators. As a result, the effects of urbanisation could vary for predation on different types of insects.

Interestingly, the two methods produced completely different results. There was significant predation on artificial prey, and the rate of predation increased with urbanisation. On the other hand, there wasn't any significant predation on live prey. Both results contradict the general pattern from previous studies, but the first result is consistent with more recent work showing increased predation in cities (Kozlov et al., 2017).

The difference in results between the two methods is important. One explanation is that the live prey method produced the true result, and there actually isn't any significant predation on insects. But it's highly unlikely for there to be no predation at all. An alternate explanation is that the live prey method was actually the less realistic one, with the artificial prey method instead producing the true result. That might sound odd, but it could occur if the cages interfered with proper predator behaviour. This study shows that different methods can produce completely different results. In future studies of predation, researchers should carefully consider the method they use to ensure that it's suitable for their particular circumstances.

Another interesting result is that predation differed among the different types of artificial prey. Predation on artificial caterpillars was roughly twice that on beetles or planthoppers. This might be because caterpillars aren't armoured like beetles and aren't good jumpers like planthoppers, so to a predator like a spider, caterpillars (even artificial ones) look like easy prey. But predation still increased with urbanisation for all three types of prey, which suggests that this pattern is robust and likely to apply to predation on insects in general.

Looking at the bigger picture, predation on insects may increase in cities compared to natural environments. This could be a good thing if it means fewer pests on urban plants. However, it could also have negative effects if it means more predation on valuable insects such as pollinators.

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What's in a name – the strange names taxonomists give to newly discovered insects

A quick google search will reveal a strange recent phenomenon of naming new discovered species after famous people, particularly TV and movie celebrities. However, it is not really a recent phenomenon. In 1913, Alexandre Girault named a species of Chalcid wasp, *Ablerus longfellowi*, after the American poet Henry Longfellow. More infamously, *Anophthalmus hitleri,* an eyeless cave dwelling carabid beetle from Slovenia*,* was named by Oskar Scheibel in 1931 after Adolph Hitler. Ironically, it is now highly endangered, found in only five caves in Slovenia, because neo-Nazi collectors have over collected it.

In recent times, American politicians have also got a guernsey. Three species of the Leiodid beetle genus *Agathidium* were named after George Bush, Dick Cheney and Donald Rumsfeldi. Musician and movie stars have also been featured recently. Species of *Agra*, a carabid beetle genus, have been named after Arnold Schwarzenegger and Liv Tyler and species of *Aeiodes*, a Braconid parasitoid wasp genus, have been named after Ellen Degeneres, Jimmy Fallon, Lady Gaga and Shakira. Maybe there was irony in the choices by Shimbori and Shaw (2014). Musicians feature heavily with one of the first being Frank Zappa – *Amaurotoma zappa,* a fossil snail, described by Leo P. Plas jr in 1972, as well as a phialella jellyfish (*Phialella zappai*) and a spider from Cameroon (*Pachygnatha zappa) supposedly* named because a marking on the female's ventral surface resembles the Zappa mustache. Two stoneflies of the genus *Anacroneuria,* were named by Bill Stark in 2004 after James Taylor and Carol King, because of their concern for the environment…….and we can go on.

One of the great naturalists of our time, David Attenborough, has many species, including some insects and spiders named after him, and rightly so. This brings us to the crux of the article. Many Australian entomologists have had invertebrates named in their honour. The recent publicity for Geoff Monteith, a Queensland-based member of the NSW Entomological Society, prompts the question: how many other current members have been honoured in this way. Geoff was recently identified as one of the top ten biologists/naturalists in history with respect to the number of organisms named in his honour, in the illustrious company of Charles Darwin, Alfred Russel Wallace and Joseph Banks. Geoff has 225 species and 15 genera named after him according to Stephen Heard in his book *Charles Darwin's Barnacle and David Bowie's Spider: How Scientific Names Celebrate Adventurers, Heroes, and Even a Few Scoundrels.* Geoff informed me yesterday that this has risen to 235 species and 17 genera since the publication of the book. A quick canvas of members showed that Geoff is not alone. There are quite a few current members that have been honoured in this way, albeit not to the same extent (see below). Max Moulds, George Bornemissza and George Hangay were the most recognised entomologists in our society by this metric.

I've included George Bornemissza in this list although George passed away in 2014. However, his wife Jo and best friend Mike Bouffard remain members of the society. Note, I have not attempted to list all those species and genera named after Geoff Monteith, as it would take many (many) pages.

Member	*Species*	Author	Taxa
George Bornemissza	*Carbrunneria bornemisszai*	Princis, 1954	Blattodea: Ectobiidae
	Osa bornemisszai	Paramonov 1958	Diptera: Pyrgotidae
	Polypauropus bornemisszai	Remy, 1961	Myriapoda: olypauropodidae
	Symphylella bornemisszai	Scheller, 1961	*Symphyla: Scolopendrellidae*
	Ipomyia bornemisszai	Colless, 1965	Diptera: Cecidomyiidae
	Beierolpium bornemisszai	Beier, 1966	Pseudoscorpiones: Olpiidae
	Pseudotyrannochthonius bornemisszai	Beier, 1966	Pseudoscorpiones: Pseudotyrannochthoniidae
	Eosentomon bornemisszai	Tuxon, 1967	Protura: Eosentomidae
	Copris bornemisszai	Ferreira, 1968	Coleoptera: Scarabaeidae
	Neosisyphus bornemisszai	Ferreira, 1968	Coleoptera: Scarabaeidae
	Onthophagus bornemisszai	Matthews, 1972	Coleoptera: Scarabaeidae
	Onthophagus bornemisszanus	Matthews, 1972	Coleoptera: Scarabaeidae
	Temnoplectron bornemisszai	Matthews, 1974	Coleoptera: Scarabaeidae
	Sisyphus bornemisszanus	Endrödi, 1983	Coleoptera: Scarabaeidae
	Clambus bornemisszai	Endrödy-Younga, 1990	Coleoptera: Clambidae
	Hoplogonus bornemisszai	Bartolozzi, 1996	Coleoptera: Lucanidae
	Lissotes bornemisszai	Bartolozzi, 2003	Coleoptera: Lucanidae
	Setoppia bornemisszai	Balogh, 1982	Acari: Oribatida: Oppiidae
	Acutozetes bornemisszai	J. & P. Balogh, 1986	Acari : Haplozetidae
	Viracochiella bornemisszai	Balogh & Mahunka, 1996	Acari: Ceratozetidae
Graham Brown	*Tricharnhemia browni*	Baehr 2009	Coleoptera: Carabidae
	Adelotopus browni	Baehr 1997	Coleoptera: Carabidae
	Rhytidortalis browni	McAlpine 2000	Diptera: Platystomatidae
George Hangay	*Clambus hangayi*	Endrody-Younga 1990	Coleoptera: Clambidae
	Aulacocyclus hangayi	Van Doesburg 1992	Coleoptera: Passalidae
	Thaumastopeus palawanicus hangayi	Arnaud & Delpont 2001	Coleoptera: Scarabaeidae
	Oxycheleila hangayi	Wiesner 2003	Coleoptera: Carabidae
	Helluosoma hangayi	Baeher 2005	Coleoptera: Carabidae
	Pseudomicrocara hangayi	Watts 2007	Coleoptera: Scirtidae
	Pollaplonyx hangayi	Keith 2008	Coleoptera: Scarabaeidae
	Bunbunius hangayi	Keith 2008	Coleoptera: Scarabaeidae
	Hangayana enigmatica	Matthews & Merkl 2015	Coleoptera: Tenebrionidae
	Epithecia extremata hangayi	Vojnits 1977	Lepidoptera: Geometridae
	Coenotephria ablutaria hangayi	Vojnits 1986	Lepidoptera: Geometridae
	Cidaria salicata hangayi	Vojnits 1986	Lepidoptera: Geometridae
	Pseudoparentia hangayi	Bickel 1994	Diptera: Dolichopodidae
	Trypetimorpha hangayi	Orosz 2012	Hemiptera: Tropiduchidae
	Pedrocortesella hangayi	Hunt 1996	Acari: Licnodamaeidae
Max Moulds	*Oedaspis mouldsi*	Hardy & Drew, 1996	Diptera: Tepheitini
	Signa mouldsi	McAlpine, 2001	Diptera: Platystomatidae
	Phytalmia mouldsi	McAlpine & Schneider, 1978	Diptera: Tephritidae
	Plagiozopelma mouldsorum	Bickel, 1994	Diptera: Dolichopodidae
	Paranomina mouldsorum	McAlpine, 2019	Diptera: Lauxaniidae
	Molophilis mouldsi	Theischinger, 1988	Diptera: Limoniidae
	Melanotus mouldsi	Calder, 1983	Coleoptera: Elateridae
	Australobolbus mouldsi	Howden, 1992	Coleoptera: Geotrupidae
	Mouldsia **new genus**	Smithers, 1978	Psocoptera: Myopsocidae

Member	*Species*	Author	Taxa
Max Moulds (continued)	*Heterocaecilius mouldsi*	Smithers, 1996	Psocoptera: Pseudocaeciliidae
	Psocidus mouldsi	Smithers, 1984	Psocoptera: Psocidae
	Epipsocopis mouldsi	Smithers, 1996	Psocoptera: Epipsocidae
	Philotarsopsis mouldsi	Thornton & New, 1977	Psocoptera: Philotarsidae
	Megalohelcon mouldsi	Austin, Wharton & Dangerfield, 1993	Hymenoptera: Braconidae
	Pristaulacus mouldsi	Jennings, Austin & Stevens, 2004	Hymenoptera: Aulacidae
	Macroglossum mouldsi	Lachlan & Kitching, 2001	Lepidoptera: Sphingidae
	Psilogramma maxmouldsi	Eitschberger, 2001	Lepidoptera: Sphingidae
	Marumba mouldsi	Eitschberger, 2001	Lepidoptera: Sphingidae
	Inflatopyga mouldsi	Duffels, 1997	Hemiptera: Cicadidae
	Nigripsaltria mouldsi	de Boer, 1999	Hemiptera: Cicadidae
	Orphninus mouldsi	Emeljanov, 2000	Hemiptera: Cixiidae
	Mitelloides mouldsorum(=*mouldsi*)	Stevens, 1991	Hemiptera: Cicadellidae
	Kaltetartessus mouldsi	F. Evans, 1981	Hemiptera: Cicadellidae
	Burbunga mouldsi	Olive, 2012	Hemiptera: Cicadidae
	Birdantis mouldsi	Constant, 2011	Hemiptera: Fulgoridae
	Carvaka mouldsorum	Fletcher & Semeraro, 2007	Hemiptera: Cicadellidae
	Micropodacanthus mouldsi	Brock & Hasenpusch, 2007	Phasmida: Phasmatidae
	Chimarra mouldsi	Cartwright, 2002	Trichoptera: Philopotamidae
	Triaenodes mouldsi	Neboiss & Wells, 1998	Trichoptera: Leptoceridae
	Oecetis mouldsi	Wells, 2006	Trichoptera: Leptoceridae
	Nososticta mouldsi	Theischinger, 2000	Odonata: Platycnemididae
	Austrogomphus mouldsorum	Theischinger, 1999	Odonata: Gomphidae
	Myrmeleon mouldsorum	New & Smithers, 1994	Neuroptera: Myrmeleontidae
	Stilbopteryx mouldsorum	Smithers, 1989	Neuroptera: Myrmeleontidae
	Theristria mouldsorum	Lambkin, 1986	Neuroptera: Mantispidae
	Fissuleon mouldsorum now Glenoleon	(New ,1985)	Neuroptera: Myrmeleontidae
	Austrosialis maxmouldsi	Theischinger, 1983	Megaloptera: Sialidae
	Trinotoperla mouldsi	Theischinger, 1982	Plecoptera: Gripopterygidae
	Caeculisoma mouldsi	Southcott, 1988	Acarina: Erythraeidae
	Corasoides mouldsi	Humphrey, 2017	Araneae: Desidae
Garry Webb	*Webbella* **new genus**	Britton 1988	Coleoptera: Scarabaeidae
NB. I haven't confirmed whether any of these species are still current.			

Oh, if I've missed anyone, I apologise in advance. Please let me know and I'll include it the next edition of Tarsus (don't be shy).

Garry Webb

Further Reading:

https://morethanadodo.com/2013/03/06/the-etymology-of-entomology/

https://thenewdaily.com.au/news/people/2017/02/08/david-attenborough-animals/?gclid=CjwKCAiAu8SABhAxEiwAsodSZCTe1P4Df7P_qUhk3vNsF-ZBz8L2MezRrAkkusKHlCKIUE85dRMSsRoCln0QAvD_BwE

https://www.abc.net.au/news/2020-10-04/scientist-geoff-monteith-ranked-alongside-charles-darwin/12726162

New Entomological Research

(**Right Click** on the titles (or **CTRL Right Click**) to see the full articles)

Reduce insecticide spraying by using ant pheromones to catch crop pests

Scientists at the Universities of Bath and Sussex have developed a new system that slowly releases ant pheromones to attract pests to an insecticide bait. This means that instead of spraying the whole crop with pesticides, traps can be placed in specific areas for more targeted protection. Leaf-cutting ants are major pest species of agriculture and forestry in many areas of the tropics causing an estimated $8 billion damage each year to eucalyptus forestry in Brazil alone. Traditional pesticides often degrade quickly and are not specific to particular pests, resulting in substantial wastage of pest control products, environmental contamination and harmful effects on other insects. The team of chemists and chemical engineers at Bath used molecular sponges called metal-organic frameworks (MOFs), to soak up the alarm pheromones of leaf cutter ants and then slowly release them to attract the insects to a trap.

Fighting mosquito-borne diseases... with mosquitoes

For decades, researchers have scratched their heads over how to combat deadly mosquito-borne diseases such as dengue fever. But could the solution come from producing mosquitoes? The French company InnovaFeed, specialised in the production of insects to feed livestock, is partnering with the Australian research World Mosquito Program (WMP) to develop what it says is the first industrial-level production of mosquitoes. These mosquitoes can then be modified and sent into wild populations in order to keep numbers down. As infection rates of illnesses carried by mosquitoes increase, companies and researchers are racing to develop effective means of controlling the blood-sucking creatures' population. Dengue cases have multiplied by eight in the past two decades, going from 500,000 cases in 2000 to 4,2 million in 2019. In most cases, dengue provokes a fever, nausea and muscle and joint pains, but it can become deadly if it provokes internal bleeding or attacks vital organs. Dengue and zika virus are genuine problems for France as there have been major outbreaks in recent years at its overseas territories in the Indian Ocean, Pacific and South America. "The idea is to help cities on a large scale, with several million people," cofounder of InnovaFeed Aude Guo told AFP.

New study shows evolutionary breakdown of 'social' chromosome in ants

Scientists from Queen Mary University of London have found that harmful mutations accumulating in the fire ant social chromosome are causing its breakdown. The chromosome, first discovered by researchers at the University in 2013, controls whether the fire ant colony has either one queen or multiple queens. Having these two different forms of social organization means the species can adapt easily to different environments and has resulted in them becoming a highly invasive pest all over the world, living up to their Latin name *Solenopsis invicta*, meaning "the invincible." For the new study, published in *eLife*, the research team performed detailed analyses of the activity levels of all the genes within the social chromosome for the first time to understand how it works and its evolution. They found that damaging mutations are accumulating in one version of the social chromosomes, causing it to degenerate. The findings also showed that most of the recent evolution of these chromosomes stems from attempts to compensate for these harmful mutations.

Could an insect repellent with citriodiol help fight the bite of COVID-19? Not so fast

British soldiers have reportedly been given insect repellent to help protect themselves against COVID-19. The UK government's Defence Science and Technology Laboratory released a study showing the citriodiol-based spray can kill SARS-CoV-2, the coronavirus that causes COVID-19, in a lab. We're all on the lookout for new ways to get the best protection against COVID-19. But just because a product is safe to use in its current form, it doesn't necessarily mean it will provide either safe or sufficient protection against COVID-19.

What did the katydids do when picking up bat sounds?

Ecosystems can be incredibly complex, with many interacting species. In many habitats, predators shape they behavior of prey and prey shape the behavior of predators. This paper provides a detailed look at the predator-prey relationship between bats and katydids, a group of insects related to crickets and grasshoppers. Some species of bats hunt katydids by eavesdropping on their mating calls. However, katydids aren't defenseless. Many species of katydids have ears that can hear the ultrasonic echolocation calls of bats. In some habitats, katydids stop calling when they hear the echolocation calls of bats. We studied katydids in Neotropical forests and predicted that they would stop calling when they heard the echolocation calls of approaching bats. What we found was a surprise—most of the katydid species continued calling even when hearing the echolocation calls of predatory eavesdropping bats. In Neotropical forests, there are many species of bats. Some of these bats eat fruit and others catch flying insects. Most of these bat species are no risk to a perched, singing katydid. However, all of these bats produce echolocation, so while the forest is full of echolocation calls, less than 4% of those calls come from bats that might eavesdrop on katydid calls. For a katydid, this means that calling is very risky, but because there are so many bats producing echolocation calls, if katydids stop singing when they hear echolocation, they would have few opportunities to attract a mate.

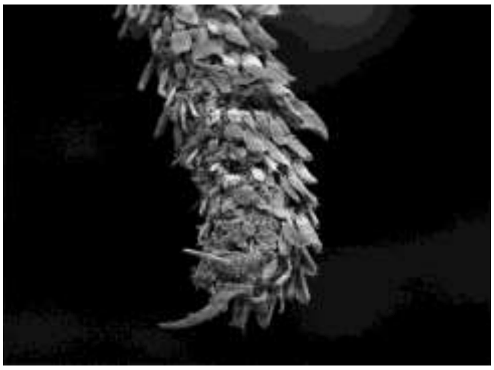
Why wasps become so annoying at the end of summer

The sausages are sizzling, the burgers browned, and the beer is cold. You're all set for the perfect end-of-summer BBQ. Alfresco dining, drinks in a garden of a country pub, ice-creams—we grasp at the last shreds of summer, precious times with loved ones before an uncertain winter of local lockdowns and Zoom. And then an unwanted visitor arrives. Jazzily dressed, trim-waisted, your uninvited guest is brimming with confidence. She's carefree and cocky—anyone's sweet drink is hers for the taking. If you stand in her way or brush her aside, you'll find she's got a nasty surprise in her stripy derriere. As the end of the summer approaches, so does wasp season, when these hated insects start to bother us at our picnics and beer gardens. It happens every year, without fail, and feels especially rude at a time when we're counting the few days we have left for outdoor, coronavirus-friendly socialising. There are no silver linings to a pandemic-gripped world. But one thing it has perhaps given us is a word to explain the late-summer antisocial behaviour of wasps: furlough. And as someone who spends their time researching wasps, a word to excuse their bad behaviour is pretty exciting. If you are one of the many people furloughed right now, you are especially well placed to understand the late-summer wasps.

Honeybee venom kills breast cancer cells, Aussie scientist discovers

Venom from the garden-variety honeybee is effective at killing breast cancer cells, as Aussie scientist discovered in an astonishing study. Bee venom is effective in killing aggressive breast cancer cells, an astonishing new study from an Aussie scientist has found. Results revealed the venom – from honeybees sourced in Western Australia, England and Ireland – rapidly destroyed triple-negative breast cancer and HER2-enriched breast cancer cells. The scientist behind the research, Dr Ciara Duffy, said a specific concentration of honeybee venom could kill 100 per cent of cancer cells. She said the treatment had minimal effects on normal cells. "The venom was extremely potent," she said. Dr Duffy, from the Harry Perkins Institute of Medical Research and The University of Western Australia, used the venom from 312 bees to test the effect on the clinical subtypes of breast cancer, including types with limited treatment options.

Volcanic Rock Yields a New Kind of Insecticide for Mosquitoes



Mosquitoes spread microorganisms that cause dangerous diseases, including malaria, dengue virus, yellow fever, West Nile virus, and Zika virus. Malaria alone causes 400,000 deaths per year. Chemical insecticides have been widely used to control mosquito populations, but insecticide resistance to pesticides has become widespread in mosquito populations, making insecticides less effective over time. Therefore, there is an urgent need for insecticides with alternative modes of action that can control mosquito populations without causing cross-resistance to chemical insecticides. North Carolina State University's Jean M. Deguenon, Ph.D., R. Michael Roe, Ph.D., and colleagues tested a material derived from volcanic rock, perlite, as a potential non-chemical insecticide against *Anopheles gambiae*, one of the primary mosquitoes that spreads malaria in Africa. In their new report published in August in the *Journal of Medical Entomology*, they show that perlite has encouraging potential as a mechanical insecticide.

In butterfly battle of sexes, males deploy 'chastity belts' but females fight back

Some male butterflies go to extreme lengths to ensure their paternity -- sealing their mate's genitalia with a waxy "chastity belt" to prevent future liaisons. But female butterflies can fight back by evolving larger or more complex organs that are tougher to plug. Males, in turn, counterattack by fastening on even more fantastic structures with winglike projections, slippery scales or pointy hooks. It's a battle that pits male and female reproductive interests against one another, with the losing sex evolving adaptations to thwart the winner's strategies.

Engineering speciation events in insects may be used to control harmful pests

pecies typically evolve over the course of eons, but researchers at the University of Minnesota have developed a way to do it in less than a year. A team of scientists led by Mike Smanski, Ph.D., in the College of Biological Sciences (CBS) has generated speciation events in fruit flies so that engineered strains can reproduce normally with each other, but mating with unmodified flies results in non-viable offspring. This research, published in *Nature Communications*, provides the foundations for scientists to be able to prevent genetically modified organisms (GMOs) from reproducing with wild organisms. Additionally, the research will allow scientists to develop new tools to control populations of disease carrying insects and invasive species in a highly targeted fashion. "Speciation is a fundamental process that drives how life evolves on this planet. Gaining engineering control over speciation will impact our ability to control pests that spread disease, harm crops or degrade the environment," said Smanski, a study author and professor in CBS. "This is one of several new approaches to pest control using modern genome-editing tools to essentially convert the pest organism into the pesticide. Any time our engineered flies attempt to reproduce with wild flies, there are no offspring. This allows it to function like a genetically-encoded birth control for pest organisms."

Scientists find clues to queen bee failure

Scientists at UBC are unravelling the mysteries behind a persistent problem in commercial beekeeping that is one of the leading causes of colony mortality -- queen bee failure. This occurs when the queen fails to produce enough fertilized eggs to maintain the hive, and is regularly cited by the Canadian Association of Professional Apiarists as one of the top causes of colony mortality. In recent research outlined in *BMC Genomics*, University of British Columbia and North Carolina State University researchers identified specific proteins that are activated in queen bees under different stressful conditions: extreme heat, extreme cold, and pesticide exposure -- conditions that can affect the viability of the sperm stored in the honey bee queen's body. If the queen does not have enough live sperm to produce enough fertilized eggs to maintain its population of worker bees, the colony will eventually die out.

The Curious Case of the Spiders in the Ant-Acacia Mutualisms

Ants with a serious sting protect acacia trees from herbivorous enemies in return for room and board: At first impression, this might seem like an arthropodan protection racket, but it’s actually a wonderfully sweet deal for both parties. It’s even more of a bargain for certain orb-weaving spiders that freeload off the arrangement, creating a triangular relationship unraveled by researchers working in the steamy forests of central Panama and described in a new report published in August in the *Journal of Insect Science.* The interaction between ant and acacia, in which two species benefit from an arrangement between them, is called mutualism. The ants, whose sting is horrendously painful, create a second layer of defense besides the thorns acacias brandish against creatures that might munch on them. The covenant gives the ants a place for their colony to live and provides food in the form of sugars, fats, and proteins from structures on the leaves. Enter the spiders *Eustala oblonga* and *Eustala illicita*: small and inconspicuous enough to hide from ants during the day, crouching against leaves, stems, and thorns while deploying their webs among the leaves by night. The ant patrols and the acacia itself shield the spiders from predators such as wasps, assassin bugs, stinkbugs, anoles, and birds. The thorny tree also provides a platform for the spiders’ webs and attracts some of the insects on which they feed.

Little Organisms, Big World: Insect Gut Bacteria Partnerships

Gut bacteria are exceptionally tiny, but the roles they play for their insect hosts are huge. And understanding those roles may even offer insight into some of the biggest questions—like how symbionts evolved into their roles in the first place. In a paper published August 20 in the *Journal of Insect Science*, Clemson University M.S. candidate Roy Kucuk reviews the literature to reveal the diverse relationships between holometabolous insects and their gut bacteria. Holometabolans (insects that undergo a complete metamorphosis with distinct larval and pupal life stages) comprise a ginormous clade, covering 11 living orders and about 850,000 species. Those orders include the four largest: Coleoptera (beetles), Hymenoptera (bees, ants, and wasps), Diptera (true flies), and Lepidoptera (butterflies and moths). So, it probably goes without saying that the group is strikingly diverse, and that broad range of insects is an ideal window through which to view the varied relationships between hosts and their gut symbionts.

Anti-reflective coating inspired by fly eyes

The eyes of many insects, including the fruit fly, are covered by a thin and transparent coating made up of tiny protuberances with anti-reflective, anti-adhesive properties. An article published in the journal *Nature* reveals the secrets of how this nano-coating is made. The authors, from the University of Geneva (UNIGE) and University of Lausanne (UNIL) -- together with ETH Zurich (ETHZ) -- show that the coating only consists of two ingredients: a protein called retinin and corneal wax. These two components automatically generate the regular network of protuberances by playing the roles of activator and inhibitor, respectively, in a morphogenesis process modelled in the 1950s by Alan Turing. The multi-disciplinary team even succeeded in artificially reproducing the phenomenon by mixing retinin and wax on different kinds of surface. This process, which is very inexpensive and is based on biodegradable materials, was used to obtain nano-coatings with a morphology similar to that of insects, with anti-adhesive and anti-reflective functionalities that could have numerous applications in areas as diverse as contact lenses, medical implants and textiles.

Coconut rhinoceros beetle makes unexpected 'host shift' to Guam's cycad trees

Researchers at the Western Pacific Tropical Research Center at the University of Guam have documented what biologists call a "host shift" of the coconut rhinoceros beetle in Guam. The beetle, first documented as an invasive species in Guam in 2007, has been devastating the island's ubiquitous coconut palms and is now also burrowing into Guam's endangered native cycad tree, Cycas micronesica. The results were published in June in Volume 13 of the *Communicative &*

Integrative Biology journal. The fact that coconut palms were the second most abundant tree on the island prior to the beetle's invasion was one factor that enabled the beetle's explosive population growth. The sustained efforts to develop an effective biological control program have not been effective, allowing the pest to establish a foothold throughout the island. "Our initial alarm after documenting the CRB burrowing activity on cycad trees was the fact that Guam's cycad species was actually the most abundant tree on the island only 20 years ago," said Irene Terry, one of the authors of the study. "Where else have the most abundant and second most abundant forest species been threatened by the recent invasion of one non-native herbivore?"

This Brave Scientist Deliberately Feeds Himself to Infected Mosquitoes For Science

It started with an arm covered in mosquitoes. But this wasn't just your unlucky friend at a summer barbecue. Perran Ross's arm was lunch for a swarm of mosquitoes infected with a bacterium called *Wolbachia* – part of a sweeping and ambitious strategy to rid the world of dengue fever. Those that have experienced dengue fever aren't likely to forget it. The dengue virus passes between humans via mosquitoes, with those infected suffering headaches, vomiting, muscle pains, skin rash, and a characteristic high fever for days on end. A smaller subsection of cases goes on to develop dengue haemorrhagic fever or shock syndrome – causing bleeding under the skin and severe vomiting. The number of infections are going up year on year, and in 2019 the World Health Organisation (WHO) recorded 4.2 million cases, although thankfully relatively few deaths. In certain places like Australia, though, dengue outbreaks are a thing of the past.

Study resolves the position of fleas on the tree of life

A study of more than 1,400 protein-coding genes of fleas has resolved one of the longest standing mysteries in the evolution of insects, reordering their placement in the tree of life and pinpointing who their closest relatives are. The University of Bristol study, published in the journal *Palaeoentomology*, drew on the largest insect molecular dataset available. The dataset was analysed using new statistical methods, including more sophisticated algorithms, to test all historically proposed hypotheses about the placement of fleas on the insect tree of life and search for new potential relationships . The findings overturn previously held theories about fleas, the unusual anatomy of which has meant that they eluded classification in evolutionary terms. According to the authors of the study, contrary to popular belief, fleas are technically scorpionflies, which evolved when they started feeding on the blood of vertebrates sometime between the Permian and Jurassic, between 290 and 165 million years ago. The closest living relatives of fleas are the members of the scorpionfly family Nannochoristidae, a rare group with only seven species native to the southern hemisphere. Unlike the blood-thirsty fleas, adult nannochoristid scorpionflies lead a peaceful existence feeding on nectar.

Soap and cotton won't remove ticks safely

For years there has been a social media post doing the rounds claiming to have the safe and easy way to remove ticks. The 2013 Facebook past, from a nurse, involved just soap and a cotton ball. But experts have told AAP FactCheck that despite being shared 27,000 times, the remedy doesn't hold up to inspection. The recommended way to remove ticks is by freezing, or using tweezers, forceps or a tick remover, they say. Ticks, with a "mouthful of hooks" attach themselves deeply to skin to feed on blood which can, in the process, transmit bacteria and viruses through their saliva. The original remedy was to "apply a glob of liquid soap to a cotton ball, cover the tick with the soap-soaked cotton ball and swab it for a few seconds", before the tick would come out on its own, stuck to the cotton ball. The reality, however, is not so easy, and the soapy cotton ball remedy is not recommended for the 70 species of ticks in Australia and more than 800 around the world.

How Blow Flies Compete (or Not) for Decomposition Duties

Blow flies—or, more precisely, the squirmy maggots that are their larvae—are as familiar to fans of crime dramas as Sherlock Holmes or Miss Marple. Best-selling crime novelist Patricia Cornwell even wrote a book titled *Blow Fly.* By examining maggots doing their thing on a corpse, forensic investigators can find all sorts of clues as to how and when a person became one. Species of maggots can indicate, for example, the time of death, because some adult females arrive and lay eggs minutes after the last breath; others later, in succession. If eggs from a species that prefers a moist environment are found on a corpse in a dry area, chances are the body was moved after death. A new study by a Florida International University researcher, published this month in *Environmental Entomology,* supports the idea that timing of egg laying by different species is an adaptation that has evolved so they can avoid competition within the egg laying environment. (Read “environment” as a dead body.) If a warming climate raises seasonal temperatures sufficiently, says author Amber E. MacInnis, the variety and proportion of blow fly species available for sampling by forensic investigators might change, posing a potential issue for investigators. Only in an extreme case might the variety of blow fly species on a corpse be truly scrambled because of rising temperatures, says MacInnis, “but it is not out of the realm of possibility. What is more likely [is that] the number of a species could decrease [and] might not be collected due to low numbers.”

These Insect Costume Designers are Dressed to Impress

Halloween is upon us, and for many people that means transforming themselves into fantastic creatures or characters. Feeling stuck deciding on a costume? Take inspiration from these insects that are masters of disguise!. Lacewing larvae (Neuroptera: Chrysopidae) are colloquially known as "junk bugs" due to their propensity for piling rubbish upon their backs. Environmental debris like lichen, moss, and dirt are popular choices, but junk bugs will sometimes even add the carcasses of their prey to the load. These junk piles disguise the lacewing larvae, camouflaging them both visually and chemically from potential predators including cannibalistic con-specifics. If detected, the debris can form a protective barrier against attack. In a study between *Mallada desjardinsi* lacewings and multicolored Asian lady beetles (*Harmonia axyridis*), lacewing larvae with junk piles experienced far lower detection and capture rates than larvae whose piles had been removed.

Ogre-faced spiders catch insects out of the air using sound instead of sight

Some spiders wait for prey to come and tickle their web. But the ogre-faced spider (*Deinopis spinosa*) uses its sense of hearing to take its web to the prey. Hanging upside down, the spider weaves a rectangular web between its legs. When an insect flies behind the dangling arachnid, the spider swings backward, casting the web toward the prey. This behind-the-back hunting technique is one clue that the spiders can hear an unexpectedly wide range of sounds, researchers report online October 29 in *Current Biology.* "A couple years ago, we didn't really have a great idea that spiders could hear," says Jay Stafstrom, a sensory ecologist at Cornell University. But now, he and his colleagues have looked at several spider species, and most can hear using specialized organs on their legs, he says. That includes jumping spiders, which respond to low frequencies (*SN: 10/15/16*). Surprisingly, ogre-faced spiders can also hear fairly high frequencies, Stafstrom says.

Australian Night Bees Recorded Foraging in Darkness for the First Time

A new study has identified two Australian bees that have adapted their vision at night for the first time. Australian bees are known for pollinating plants on beautiful sunny days, but a new study has identified two species that have adapted their vision for night-time conditions for the first time. The study by a team of ecology researchers has observed night time foraging behavior by a nomiine (*Reepenia bituberculata*) and masked (*Meroglossa gemmata*) bee species, with both developing enlarged compound and simple eyes which allow more light to be gathered when compared to their daytime kin. Published in the *Journal of Hymenoptera Research*, the researchers explain that this improved low-light ability could potentially also exist in other Australian species secretly active at night, with their image processing ability best observed through high-resolution close-up images. Lead author PhD Candidate James Dorey, in the College of Science & Engineering at Flinders University, says the two Australian bee species active at night and during twilight hours are mostly found in Australia's tropical north, but there could potentially more in arid, subtropical, and maybe even temperate conditions across the continent.

Invasive keyhole wasp builds nests in aircraft instruments

You'd probably shoo it away without a second thought, but a wasp that's recently called Australia home can pose a "significant risk" to passenger aircraft safety in Brisbane and beyond, research finds. The study, due to be published in the journal PLOS One today, came off the back of a series of incidents at Brisbane airport where wasp nests, constructed in an aircraft's speedometer, forced planes to abandon take-off or even turn back after departure. A few types of nesting wasps live in the Brisbane area, but no-one knew which was responsible for cutting flights short. The culprit — a small black wasp with yellow bands on its pointed abdomen nicknamed the keyhole wasp (*Pachodynerus nasidens*) — is a recent arrival to our shores. Native to the Caribbean and South and Central America, it was discovered in Australia during a routine quarantine check at the Port of Brisbane in 2010, and first spotted at Brisbane Airport two years later.

Beetle larvae think with brain 'under construction'

In the human brain, hundreds of billions of nerve cells are interconnected in the most complicated way, and only when these interconnections are correctly made, can the brain function properly. This is no different for insects, even though their brains consist of 'only' one hundred thousand to one million nerve cells. Nevertheless, fascinating and unexpectedly complicated behaviour can be observed in insects, for example when rearing offspring in the bee hive or when mosquitoes search for blood. To a large extent, the brain develops in the embryo, but in many animals it is completed only after birth. Now, biologists from the University of Göttingen have found out that beetle larvae start using their brains, although still 'under construction'. The results have been published in the journal *PLOS Biology*.

Charles Darwin was right about why insects are losing the ability to fly

Most insects can fly. Yet scores of species have lost that extraordinary ability, particularly on islands. On the small islands that lie halfway between Antarctica and continents like Australia, almost all the insects have done so. Flies walk, moths crawl. "Of course, Charles Darwin knew about this wing loss habit of island insects," says PhD candidate Rachel Leihy, from the Monash University School of Biological Sciences. "He and the famous botanist

Joseph Hooker had a substantial argument about why this happens. Darwin's position was deceptively simple. If you fly, you get blown out to sea. Those left on land to produce the next generation are those most reluctant to fly, and eventually evolution does the rest. Voilà." But since Hooker expressed his doubt, many other scientists have too. In short, they have simply said Darwin got it wrong. Yet almost all of these discussions have ignored the place that is the epitome of flight loss -- those 'sub-Antarctic' islands. Lying in the 'roaring forties' and 'furious fifties', they're some of the windiest places on Earth. "If Darwin really got it wrong, then wind would not in any way explain why so many insects have lost their ability to fly on these islands," said Rachel.

Arachnauts: NASA Sends Spiders to Space for Experimentation – Here's What They Found

Humans have taken spiders into space more than once to study the importance of gravity to their web-building. What originally began as a somewhat unsuccessful PR experiment for high school students has yielded the surprising insight that light plays a larger role in arachnid orientation than previously thought. The spider experiment by the US space agency NASA is a lesson in the frustrating failures and happy accidents that sometimes lead to unexpected research findings. The question was relatively simple: on Earth, spiders build asymmetrical webs with the center displaced towards the upper edge. When resting, spiders sit with their head downwards because they can move towards freshly caught prey faster in the direction of gravity. But what do arachnids do in zero gravity? In 2008, NASA wanted to inspire middle schools in the US with this experiment. But even though the question was simple, the planning and execution of the experiment in space was extremely challenging. This led to a number of mishaps. Two specimens from different spider species flew to the International Space Station (ISS) as "arachnauts," one (*Metepeira labyrinthea*) as the lead and the other (*Larinioides patagiatus*) as a reserve in case the first didn't survive.

Genomic Study Reveals Evolutionary Secrets of Banyan Tree and a Wasp That Coevolved With It

The banyan fig tree *Ficus microcarpa* is famous for its aerial roots, which sprout from branches and eventually reach the soil. The tree also has a unique relationship with a wasp that has coevolved with it and is the only insect that can pollinate it. In a new study, researchers identify regions in the banyan fig's genome that promote the development of its unusual aerial roots and enhance its ability to signal its wasp pollinator. The study, published in the journal *Cell*, also identifies a sex-determining region in a related fig tree, *Ficus hispida*. Unlike *F. microcarpa*, which produces aerial roots and bears male and female flowers on the same tree, *F. hispida* produces distinct male and female trees and no aerial roots.

Photo Corner

All Society member are encouraged to submit any entomological photographs of interest together with a short (or long) description of your observations.

A wandering Cossid moth larva

(by member Ambrose, and Sonia)

On a hot summer day in December, we went for a bushwalk in Booderee National Park near Jervis Bay on the south coast of NSW. Crossing the broad path in a very determined manner was a huge "witchetty" grub. Yellow-tailed black cockatoos flew and screeched, while white-bellied sea eagles soared. There was no tree cover. The grub was visible and very vulnerable to predation. We wondered what this wandering witchetty grub was doing, and where it was going...

Unsure of the grub's identity, we later emailed photos to knowledgeable contacts. The consensus was that this witchetty grub was a Cossid moth larva; a goat moth. One of those contacts, zoologist Dr Catherine Byrne, thought that due to the shape of its head and thoracic segments, that this Cossidae possibly belonged to the subfamily Cossinae, genus *Zyganisus.* Another contact*,* Garry Webb, thought that it could also be a very mature *Endoxyla cinerea* given the size (ca. 6 inches) and the purple banding.

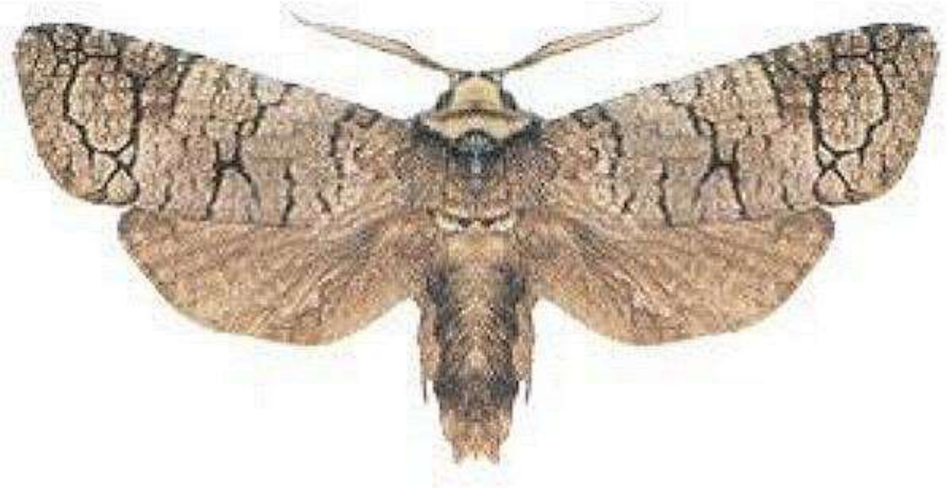
On Ambrose's YouTube channel you can see the grub in action, the link is https://youtu.be/C9UlSiIn3Vw

Garry Webb wondered why this larva was out on the path when it should be comfortably ensconced inside the stem of a wattle or Eucalypt and approaching pupation time. Garry's research revealed that cossid moth larvae usually spend their early life in the soil feeding on plant roots but later on bore into trees feeding extensively in the trunk before pupating and emerging as a fully fledged "giant" moth….and the cycle starts again. Across Australia these grubs are favoured food of cockatoos which do significant damage to eucalypt forests and plantations in trying to extract them from the trunks. The purple markings on each segment of the grub are believed to be a warning signal to predators but the question remains, why is the grub out in the open – did it escape from a cockatoo veraciously destroying its home? As there is a record of a large mature larva of *Zyganisus caligenosus* out wondering on the forest floor (Kallies and Hilton 2012) maybe this behavior is more common than we think. Maybe a society member more familiar with moths would like to share their thoughts on this minibeast?

Ambrose and Sonia would like to thank the following people for their kind assistance, and generosity of time to help identify this cute grub:

Dr Catherine Byrne (Zoologist)
Dion Maple (Natural Resources Team Leader, Booderee National Park)
Graham Owen (Society for Insect Studies)
Robert Richardson (Society for Insect Studies)
Garry Webb (The Entomological Society of NSW)
Steve Ogden (Wildlife Insight)
Don Herbison-Evans (Coffs Harbour Butterfly House)

Some images of adult cossid moths (courtesy of CSIRO)



Some other interesting links on Cossid moths.
https://youtu.be/sufCnjPlYwc
https://youtu.be/mMksb_eMGp8

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