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This month's member spotlight is Grant Herron. Grant recently retired from NSW DPI as principle research scientist and team leader of the insect resistance group.

Dinah Hales has kindly provided a short article on parasitisation of sphingid caterpillars by a tachinid fly.

This month, in the Photo Corner section, we look at Eriococcid galls on Eucalypts

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

Kind Regards

Garry Webb

Circular editor

Member Spotlight
Grant Herron

Early days
Grant finished a Bachelor of Applied Science at the NSW Institute of Technology in 1980. Early in 1981, Grant obtained a temporary Technical Officer position with help from Dr Peter Miller (then NSW Institute of Technology, currently University of Technology Sydney, and now retired) in the Entomology Branch at the Biological and Chemical Research Institute (BCRI), Rydalmere. That initial two-week position was extended multiple times working for various entomologists. Grant spent time with Dr Andrew Beattie on citrus and Graeme Baker and his grasshoppers. Grant's time as a Technical Officer finished in the mid-1980s with Howard Greening and the Royal Commission into Grain Storage and Handling. There after Grant was entrusted with the insecticide resistance research work, and given the title acting Entomologist. Grant used that work in part, to fulfil the requirements of a Graduate Diploma in Agricultural Entomology at the University of Sydney. Grant didn't know it at the time, but he had apparently impressed with his Royal Commission insecticide resistance work, well so Dr Garry Levot later told him (then NSW Department of Agriculture, currently NSW Department of Primary Industries, now retired). Grant was soon after appointed to a permanent position and for a while was the youngest entomologist in the then NSW Department of Agriculture.

A research career starts
Grant's mentor during his early career was Dr Vic Edge (Assistant Director of Entomology BCRI at the time, now retired) to whom he is forever grateful. Besides being his Director, Vic was an insecticide resistance specialist and Grant was to be part of his grand plan. Grant was thinking he would be doing stored product entomology, but no, he was to be entrusted with Victor's old research position, he was a succession plan. Grant was to be a non-crop insecticide resistance specialist that was unusual as other entomologist were commodity based. Vic Edge had done resistance work on grasshoppers, aphids and two spotted mite, *Tetranychus urticae* so no more stored products for Grant. Vic had just found clofentezine / hexythiazox resistance in two spotted mite, so Grant asked if he could do a Departmental sanctioned PhD and devise a management solution. Eventually permission was granted, and a PhD completed under the supervision of Dr Vic Edge and Dr Harley Rose (then University of Sydney, now retired).

A research career develops
With the PhD behind him (it was the most stressful thing he had ever done; Grant smiled all day at his graduation!) his research career quickly developed. Firstly, resistance was a huge issue in cotton and the system was changing with the introduction of *Bt* transgenic cotton.

Grant teamed up (it turned into a career long partnership) with a young CSIRO ecologist and entomologist named Dr Lewis Wilson (now retired) who was speculating secondary pests in cotton may become more troublesome in the transgenic era. Grant obtained cotton funding to do resistance baseline work on cotton aphid, *Aphis gossypii* just in case there was trouble. Serious control problems and spray failures soon followed. Aphids could be covered in spray like snow but still they did not die. Grant with help from Lewis Wilson saved the Australian cotton industry from 'sticky cotton' that would have devastated it. The aphid honey-dew would have ruined Australian cotton's reputation for producing a clean high-quality product that attracted a price premium. The management strategy developed was novel at the time (now written up as a review article for *Austral Entomology*) integrating both Integrated Pest Management (IPM) and resistance management. Grant had made resistance management an IPM subset when previously they were considered quite separate. At approximately the same time western flower thrips, *Frankliniella occidentalis* found its way into Australia. Here Grant led the resistance management component of the National Strategy for its control. At about this time the Biological and Chemical Research Institute was closed, and Grant moved to the Elizabeth Macarthur Agricultural Institute (EMAI), Menangle. Within the new facility Grant's entomology resistance research continued. Grant found western flower thrips had come into Australia carrying many resistances, making their management a serious challenge and causing huge crop losses. Now every Australian insecticide label includes Grant's three spray resistance and chemical control strategy for western flower thrips, again underpinned by sound IPM practice.

The times they are a changing

Grant had now become an international authority on insecticide resistance and its management and a recognised specialist (he was an invited and sponsored speaker at the 2016 ICE where he elaborated on his cotton successes). Grant was on the Research Scientist treadmill (to date about 80 peer reviewed journal articles including one in *Annual Review of Entomology*) and on various Editorial Boards. Grant was also a well-regarded Journal Editor and has refereed multiple journal manuscripts (to date his invited peer reviewing tally exceeds 300). However, it was becoming very clear that resistance research was moving away from his beloved bioassay to a DNA approach. It was time to adapt or become increasingly marginalised. A decade ago, Grant formed a strategic alliance with NSW Department of Primary Industries molecular biologist Dr Yizhou Chen. Yizhou and Grant formed a solid partnership detecting resistance using a DNA approach that is now the mainstay of what his research group does while still underpinned with bioassay. The bioassay remains an integral component because it can diagnose resistance when the mechanism is unknown and that currently includes most detoxification mediated resistance. What difference does the DNA approach make I hear you ask? Well, using bioassay, Grant took way too long (maybe 18 months or more) to work out that every Australian western flower thrips was resistant to every pyrethroid insecticide used against it. Western flower thrips had come into Australia pyrethroid resistant. Recently Grant's resistance group has looked at the newly introduced insect pests fall armyworm, *Spodoptera frugiperda* and serpentine leaf miner, *Liriomyza huidobrensis.* In just a few months using DNA based resistance detection methodology developed by Grant's team he knows both species have come into the country resistant to a range of chemicals. With this knowledge industry is quickly informed, and management strategies communicated.

And then it was time

In 2017 Grant turned 60 and his superannuation was calling. Grant's NSW Department of Primary Industries succession plan had exploded twice and worse his current industry

funded research was not concluded. Nonetheless, Grant still retired letting go of being a Principal Research Scientist. At Grant's retirement his Manager said, "and of course you will be back in your office on Monday". Not likely, I retired, Grant didn't go back until Tuesday! By now Grant had worked out the real fun in entomology was not writing journal manuscripts but mentoring. Grant was on his third succession plan and he was going to see it through. Plan three involves Dr Duong Nguyen, who has been working with Grant for a few years now, as part of his succession pathway. Duong is doing an admirable job and the future of Grant's Entomology Insecticide Resistance group is in capable hands. In 12 months or so, Grant may be done.

Parasitisation of sphingid caterpillars by a tachinid fly

Dinah Hales

This is a brief account of the lives and deaths of three caterpillars of the hawk moth *Theretra latreillei* (?*latrellii*) collected in mid-March of 2019, in Beecroft NSW. They were found when removing the garden weed *Cayratia clematidea* (F. Muell.) Domin (Vitaceae), and were taken into care. The table below, and the photographs, show the progress of the three caterpillars numbered as follows: No. 1 - Green, last instar when collected; No. 2 - brown, last instar when collected; No. 3 - green, 2nd last instar when collected. The caterpillars appeared healthy, and fed well on leaves of the host plant. It was interesting that green and brown forms were present, and that No. 3 changed from green to brown at the final larval ecdysis.

All three caterpillars, however, were carrying larval tachinid parasitoids and the progress of these was also noted. The caterpillars appeared normal to me, but in the absence of unparasitised controls it is easy for a non-lepidopterist to overlook subtle changes. The parasite load was high, with as many as 7 mature fly larvae emerging from an individual caterpillar. It is remarkable that heavily parasitised caterpillars can complete their development and pupate successfully. Clearly the parasitoids do not disrupt structures or physiological functions in the host responsible for movement, feeding, or ecdysis. Changes have been noted in the fat body and lipid profile of insects parasitised by Diptera (Horwood and Hales, 1991, Lardner and Hales, 1990). The physiology contrasts with that of insects parasitised by Hymenoptera.

Timeline of development of three caterpillars and their tachinid parasites

30.03.19	1,2	Stopped feeding	
3.04.19	1,2	pupa	
11.4.19	1,2	Parasitoid larvae emerging from pupa	
14.4.19	1,2	Parasitoids pupated	6 pupae/2 pupae
7.5.19	1,2	Parasitoids adult	5 adults/1 adult
?	3	Ecdysis to last instar, green> brown	
31.3.19	3	Stopped feeding	
6.4.19	3	pupa	
14.4.19	3	Parasitoid larvae emerging	7 pupae
7.5.19	3	First parasitoids adult.	

No 1, 24 March 2019

No. 2, 24 March 2019

No.3, 11 April 2019 (appears morphologically normal)

No.2, parasitoid larvae emerged from pupa, 11 April 2019

No. 1, 11 April 2019 parasitoid puparia. Note emergence site between abdominal segments of pupa.

Adult parasitoid (unidentified tachinid fly))

Some websites with more information about caterpillar colour change and polymorphism

The causes of colour and colour change in caterpillars of the poplar and eyed hawkmoths (*Laothoe populi* and *Smerinthus ocellata*) JOY GRAYSON, MALCOLM EDMUNDS

First published: July 1989
https://doi.org/10.1111/j.1095-8312.1989.tb01904.x

http://www.wildlifeinsight.com/guide-to-british-caterpillars/caterpillar-life-cycle/

https://www.smithsonianmag.com/smart-news/these-caterpillars-can-detect-color-using-their-skin-180972996/

http://www.raisingbutterflies.org/larva-to-pupa/larva-changes-color/

https://www.abc.net.au/news/science/2016-06-02/moth-camouflage-and-butterfly-colour-linked-to-same-gene/7466064

Physiological effects of parasitoids on their hosts

Horwood, M.A. & Hales, D.F. (1991). Fat body changes in a locust, *Chortoicetes terminifera* (Walker) (Acrididae) parasitized by a nemestrinid fly. *Archives of Insect Biochemistry and Physiology* 17: 53-63.

Lardner, R.M. and Hales, D.F. (1990). Histopathology of an aphid, *Schoutedenia lutea* parasitized by a gall midge, *Pseudendaphis* sp. *Entomophaga* 35: 557-567.

http://casas-lab.irbi.univ-tours.fr/Strand%20and%20Casas%202007_BEIP.pdf

New Entomological Research

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

Venom has contributed to the species diversity of insects and fishes, new study reveals

The extraordinary diversity of insects and fishes, the most species-rich invertebrate and vertebrate groups in the animal kingdom, is partly due to the origin of venom, a new study of their evolution has revealed. Venomous fishes and insects diversify around twice as fast as their non-venomous counterparts, the research showed. Venom provides an effective means of repelling predators or catching prey, which may allow species to exploit more opportunities in their environment, potentially leading to the formation of new species as they diversify in their ecology. Over 1 million species of insects have so far been identified, which is three-quarters of all invertebrate species on Earth. There are 31,269 species of fish, which make up almost half of all vertebrate species. Today, around 10% of fish families and 16% of insect families contain venomous species—from stingrays and catfish to wasps and mosquitoes. The research showed that venom has independently evolved at least 19-20 times in fishes and at least 28 times in insects across their evolutionary history.

Survey suggests climate change has reduced the presence of invasive Argentine ants

In 1993, Stanford University biology professor Deborah Gordon and her first graduate student, Katy Human, began a survey of ants at Stanford's Jasper Ridge Biological Preserve. Nearly 30 years, four more graduate students and scores of volunteers later, that survey continues on—and has recently yielded a surprising result. "From 1993 until the time I was doing my dissertation work, about 2000, it seemed as if Argentine ants were marching across the preserve, taking out native ants along the way," said Nate Sanders, one of Gordon's former graduate students who led the survey in the late '90s and is now a professor of ecology and evolutionary biology at the University of Michigan. "Now, with an additional 20 years of data, we see the story is more complex." That additional data, detailed in a paper published Aug. 3 in *Ecology*, has revealed that the distribution of Argentine ants in Jasper Ridge has actually receded, and further analysis suggested that climate change was a significant factor in this change. The researchers also found that over the span of the survey, overall native ant diversity increased and some native ant species have expanded their distributions.

Giant bird-eating centipedes exist — and they're surprisingly important for their ecosystem

Giant bird-eating centipedes may sound like something out of a science-fiction film — but they're not. On tiny Phillip Island, part of the South Pacific's Norfolk Island group, the Phillip Island centipede (*Cormocephalus coynei*) population can kill and eat up to 3,700 seabird chicks each year. And this is entirely natural. This unique creature endemic to Phillip Island has a diet consisting of an unusually large proportion of vertebrate animals including seabird chicks. As large marine predators, seabirds usually sit at the top of the food chain. But our new study, published in The American Naturalist, demonstrates this isn't always the case. We show how large, predatory arthropods can play an important role in the food webs of island ecosystems. And the Phillip Island centipede achieves this through its highly varied diet.

Venom of deadly Queensland spider could save heart attack victims

Researchers have discovered a treatment for heart attack victims in the most unexpected of places — the venom of one of the world's deadliest spiders. A team from the University of Queensland have developed a potentially life-saving drug candidate from a molecule found in the venom of the Fraser Island funnel-web spider. The researchers say the drug can prevent damage caused by heart attacks and extend the life of donor hearts used for organ transplants. The team was led by Dr Nathan Palpant and Professor Glenn King from UQ and Professor Peter Macdonald from the Victor Chang Cardiac Research Institute. Dr Palpant said the drug worked by stopping a "death signal" from being sent after a heart attack.

Reports of fire ant nests in Brisbane soar in recent years

The number of fire ant nests plaguing Brisbane backyards has skyrocketed, with confirmed cases five times higher than in 2014. Fire ants were first discovered in Queensland in 2001 in the south-western suburbs of Brisbane and at the Port of Brisbane, with infestations since spreading through Brisbane, Ipswich, Logan, Redlands and other areas of the south-east. But reports have soared in recent years, according to figures uncovered during budget estimates. In 2014, just 315 fire ant sites were reported and confirmed in the Brisbane council area, with that number spiking to 1629 last year. Across 10 council areas, including the Gold Coast, Ipswich and Logan, confirmed fire ant nest sites rose from 963 in 2014 to 8670 in 2020.

Common insecticide is harmful to bees in any amount: For the average bee, every little bit counts

A new UC Riverside study shows that a type of insecticide made for commercial plant nurseries is harmful to a typical bee even when applied well below the label rate. The study was published today in the journal *Proceedings of the Royal Society B: Biological Sciences*. Chemically similar to nicotine, neonicotinoids are insecticides that protect against plant-consuming insects like aphids, but seriously harm beneficial insects, like bees. They are widely used by commercial growers. Much research has focused on their use in food crops like canola, in which they are typically applied at low doses. However, this study is one of the few to examine neonicotinoid application in potted ornamental plants, which can represent more potent, acute sources of exposure to the toxin for bees. "Neonicotinoids are often used on food crops as a seed treatment," explained UCR entomologist and lead study author Jacob Cecala. "But they're usually applied in higher amounts to ornamental plants for aesthetic reasons. The effects are deadly no matter how much the plants are watered." Cecala said he was surprised by this result, given that neonicotinoids are water soluble. Going into the study, he assumed that more water would dilute the amount of harm they caused the bees. The researchers were also curious whether increased watering could benefit bees despite insecticide exposure by increasing the quantity or quality of nectar offered by the plants.

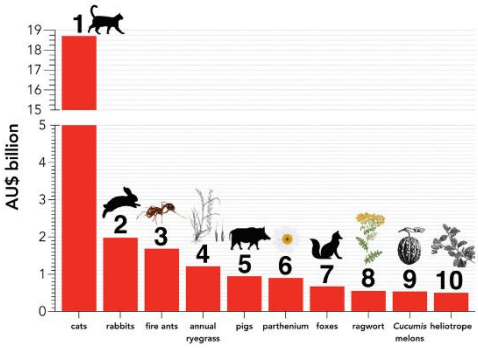
Dive Bombing Killer Flies Are So Fast – Over 3g Acceleration – They Lose Steering Control

Killer flies can reach accelerations of over 3g when aerial diving to catch their prey — but at such high speeds they often miss because they can't correct their course. These are the findings of a study by researchers at the Universities of Cambridge, Lincoln, and Minnesota, published recently in the *Journal of the Royal Society Interface*. Killer flies (*Coenosia attenuata*) perform high-speed aerial dives to attack prey flying beneath them, reaching impressive accelerations of up to 36 m/s2, equivalent to 3.6 times the acceleration due to gravity (or 3.6g). This happens because they beat their wings as they fall, combining the acceleration of powered flight with the acceleration of gravity. This is an impressive feat: diving Falcons, the fastest animals that predate in the air, achieve much lower accelerations of only 6.8m/s2. Falcons dive by folding their wings and simply letting gravity accelerate them towards their prey. For the tiny Killer fly though, the high speeds achieved in aerial dives could come as a surprise — because the researchers think the fly doesn't take the effect of gravity into account when diving to intercept a target.

Artificial light disrupts dung beetles' sense of direction

For the first time, researchers have been able to prove that city lights limit the ability of nocturnal animals to navigate by natural light in the night sky. Instead, they are forced to use streetlamps, neon light or floodlights to orient themselves. The findings are published in *Current Biology*. Some animals, including migratory birds, seals and moths, use light from the moon, stars and Milky Way to navigate at night. A team of researchers at Lund University in Sweden and the University of the Witwatersrand in South Africa have now shown how nocturnal dung beetles are forced to search for cues in their immediate surroundings when they can no longer navigate using natural light from the night sky. "These beetles are forced to abandon their celestial compass and orient using artificial light instead," says James Foster at the University of Würzburg in Germany, who led the study during his time at Lund University.

Pest plants and animals cost Australia around $25 billion a year – and it will get worse



Shamefully, Australia has one of the highest extinction rates in the world. And the number one threat to our species is invasive or "alien" plants and animals. But invasive species don't just cause extinctions and biodiversity loss – they also create a serious economic burden.

Our research, published today, reveals invasive species have cost the Australian economy at least A$390 billion in the last 60 years alone. Our paper – the most detailed assessment of its type ever published in this country – also reveals feral cats are the worst invasive species in terms of total costs, followed by rabbits and fire ants. Without urgent action, Australia will continue to lose billions of dollars every year on invasive species. Invasive species are those not native to a particular ecosystem. They are introduced either by accident or on purpose and become pests. Some costs involve direct damage to agriculture, such as insects or fungi destroying fruit. Other examples include measures to control invasive species like feral cats and cane toads, such as paying field staff and buying fuel, ammunition, traps and poisons. Our previous research put the global cost of invasive species at A$1.7 trillion. But this is most certainly a gross underestimate because so many data are missing.

Fruit fly offers lessons in good taste

What can the fruit fly teach us about taste and how chemicals cause our taste buds to recognize sweet, sour, bitter, umami, and salty tastes? Quite a lot, according to University of California, Riverside, researchers who have published a study exploring the insect's sense of taste. "Insect feeding behavior directly impacts humans in many ways, from disease-carrying mosquitos that seek human blood to pests whose appetite can wreak havoc on the agricultural sector," said Anupama Dahanukar, an associate professor of molecular, cell and systems biology, who led the study appearing in the Journal of Neuroscience. "How insect taste neurons are organized and how they function is critical for a deeper understanding of their feeding behavior." The fruit fly has multiple taste organs throughout its body to detect chemicals, called tastants, that signal whether a food is palatable or harmful. It is still unclear, however, how individual neurons in each taste organ act to control feeding. To explore this question, Dahanukar's team used the fly pharynx as a model to study whether taste information regulates sugar and amino acid consumption at the cellular level.

How a bee sees: tiny bumps on flower petals give them their intense colour — and help them survive

The intense colours of flowers have inspired us for centuries. They are celebrated through poems and songs praising the red of roses and blue of violets, and have inspired iconic pieces of art such as Vincent Van Gogh's sunflowers. But flowers did not evolve their colour for our pleasure. They did so to attract pollinators. Therefore, to understand why flowers produce such vibrant colours, we have to consider how pollinators such as bees perceive colour. When observed under a powerful microscope, most flower petals show a textured surface made up of crests or "bumps". Our research, published in the Journal of Pollination Ecology, shows that these structures have frequently evolved to interact with light, to enhance the colour produced by the pigments under the textured surface.

How do Olympic athletes stack up against invertebrates? Not very well

Olympians spend years training to be the best of the best. Scientists and sportspeople have spent decades researching the mechanics of the human body to ensure our elite athletes are always reaching higher, faster and stronger. But how do human athletic skills compare with those of insects and arachnids? Once you take the relative sizes into account, it's clear invertebrates have the winning edge.

Global warming may limit spread of dengue fever, new research finds

Infection with dengue virus makes mosquitoes more sensitive to warmer temperatures, according to new research led by Penn State researchers. The team also found that infection with the bacterium Wolbachia, which has recently been used to control viral infections in mosquitoes, also increases the thermal sensitivity of the insects. The findings suggest that global warming could limit the spread of dengue fever but could also limit the effectiveness of Wolbachia as a biological control agent. "Dengue fever, a potentially lethal disease for which no treatment exists, is caused by a virus, spread by the bite of the mosquito *Aedes aegypti*. This mosquito is also responsible for transmitting a number of disease-causing viruses, including Zika, chikungunya and yellow fever," said Elizabeth McGraw, professor and head of the Department of Biology, Penn State. "Aided by increasing urbanization and climate change, this mosquito's range is expected to overlap with 50% of the world's population by 2050, dramatically increasing the number of people who could potentially be exposed to these viruses."

Unshackled' Palm-Destroying Beetles Could Soon Invade Australia – "We Thought We'd Outsmarted Them"

A destructive pest beetle is edging closer to Australia as biological controls fail, destroying home gardens, plantations, and biodiversity as they surge through nearby Pacific islands. University of Queensland researcher Dr. Kayvan Etebari has been studying how palm-loving coconut rhinoceros beetles have been accelerating their invasion. "We thought we'd outsmarted them," Dr. Etebari said. "In the 1970s, scientists from Australia and elsewhere found that coconut rhinoceros beetles could be controlled with a beetle virus from Malaysia. "This virus stopped the beetle in its tracks and, for the last 50 years or so, it more-or-less stayed put – that is, until now. "It seems that they are now unshackled from the virus in some places and could be in Australia before we know it." In the last few years, the pest has spread to many South Pacific islands, including islands in Papua New Guinea, the Solomon Islands, and Vanuatu, causing severe agricultural and economic damage. "If they spread to Australia, garden palms would be at risk, along with the country's emerging date industry, coconuts, oil palms, and many other palms, both wild in the forests and ornamental," Dr. Etebari said.

Could tarantulas hold the secret to relieving chronic pain? Researchers think so

Using $1.5 million in funding from the National Institutes of Health, researchers at University of California, Davis, are looking into whether venom from the widely feared tarantula spider could help relieve chronic pain. "Spiders and scorpions have millions of years of evolution optimizing peptide, protein and small-molecule poisons in their venom, which we can take advantage of," said Bruce Hammock, a distinguished professor of entomology who is working on the new pain reliever. "The same venoms that can cause pain and neurological dysfunction can also help nerves work better and reduce pain." Hammock has decades of experience in developing a novel approach to relieving chronic pain. His Davis-based EicOsis earned a Fast Track designation from the U.S. Food and Drug Administration for development of an oral drug candidate, EC5026, which prevents the breakdown of compounds in the body that keep people from feeling pain out of proportion to their injury. In total, 20 researchers are studying the potential of venom from one particular spider, the Peruvian green velvet tarantula, to keep pain signals from transmitting between nerves and muscles. This spider's venom has a particular peptide associated with a specific channel that transmits pain, the Nav1.7 channel. The researchers' challenge will be getting the protein in the tarantula venom to block the Nav1.7 channels in only the sensory nerves without affecting the Nav1.7 channels in the body's muscles or brain. It's about modifying the toxin, they said, to prevent unwanted side effects. The hope is to find a pain treatment as potent as opioids, but without the addictive properties of those drugs.

What's the Big Stink About Corpse Flowers?

Splayed obscenely on the forest floor, it looks like an alien delicacy, an exotic organ meat harvested from some extraterrestrial beast and left to rot in the wake of an intergalactic debauch. With massive, fleshy petals — the entire flower may be 3 feet across — and a perfume evocative of putrefying meat, it's hardly believable that *Rafflesia arnoldii* is a member of the plant kingdom. Indeed, there are no vegetative structures in evidence.

These lurid blossoms, the largest in the world, seem to have erupted — blossomed seems too delicate a description — *ex nihilo*. But a plant it is, albeit a highly unusual one. It is a parasite, supported by three species of *Tetrastigma* vine, a tropical relative of the grape. *R. arnoldii* and its approximately 30 relatives lurk beneath the canopies of tropical rainforests from Thailand to Malaysia, Indonesia, and the Philippines. Also called corpse flowers, they differ from another species known by that name: *Amorphophallum titanum*, or the titan arum, a relative of the calla lily familiar from floral arrangements. Titan arums boast the world's largest unbranched inflorescences — massive, phallic structures boasting thousands of miniature flowers." Most *Rafflesia* are endemic to a single island and some are known from only one or two sites. All species are reliant on *Tetrastigma* vines as their hosts.

Revolutionary mosquito researchers receive $2.7 million grant

Mosquitoes may be small, but they are a formidable foe. Not only can they smell over 400 chemicals that we emit and detect the carbon dioxide we breathe out, but they can even adapt their daily behavior in response to our own. With the help of a $2.7 million grant from the National Institute of Allergy and Infectious Diseases (NIAID), researchers at Virginia Tech are now investigating how mosquitoes adjust their olfactory, or smelling, rhythms in response to changes in our own daily activity. "Mosquitoes are sometimes described as the deadliest animal on Earth," said Clément Vinauger, principal investigator on the project and assistant professor from the Department of Biochemistry in the College of Agriculture and Life Sciences. "What we are seeing is an increase in the rate of mosquitoes that become resistant to insecticides and have some other level of behavioral resistance. We need another tool or other tools to control mosquito populations."

Jumping Spiders Seem to Have a Cognitive Ability Only Previously Found in Vertebrates

Tiny little jumping spiders, with their magnificent eyes, seem to be able to do something we'd only ever seen before in vertebrates: distinguishing between animate and inanimate objects. In a new test, wild jumping spiders (*Menemerus semilimbatus*) behaved differently when presented with simulated objects of both kinds, in ways that indicated an ability to discern between them. The research doesn't just suggest that this ability can be found more widely in the animal kingdom than we knew, it demonstrates that the team's experimental setup can be used to test other invertebrates in the same way. "These results clearly demonstrate the ability of jumping spiders to discriminate between biological motion cues," the researchers wrote in their paper. "The presence of a biological motion-based detection system in jumping spiders deepens questions regarding the evolutionary origins of this visual processing strategy and opens the possibility that such mechanisms might be widespread across the animal kingdom." When you think about it, it makes sense that creatures ought to be able to distinguish between living and nonliving things. It could literally be a matter of life or death - evading predators, or chasing prey. Nevertheless, it was unclear whether or not tiny invertebrate critters rely on the ability to distinguish between motion and non-motion, or animate and inanimate objects. Jumping spiders seemed to be an excellent candidate for testing, because of their spectacularly good vision. Like most spiders, they have eight eyes; but the eyes of jumping spiders include two large, sparkling pools of limpid black on the fronts of their little faces, which possibly give them tetrachromatic color vision.

Beetle that can walk upside down under water surface filmed in Australia in world first

An Australian beetle has been observed walking upside down along the surface of water – the first instance that such behaviour has been visually documented. The tiny aquatic beetle, about 6mm to 8mm in length, has been recorded scuttling along the undersurface of a pool of water in New South Wales. John Gould, a PhD student at the University of Newcastle, discovered the beetle by accident while researching a frog species in the Watagan Mountains. Gould had been crouching down next to a body of water, searching for tadpoles, when he noticed what initially appeared to be a bug swimming. In a rare documentation of the behaviour, Gould said he then realised the beetle seemed to be walking on the underside of the water's surface as if it were a pane of glass. "I think I was just lucky," Gould said. "The most interesting thing is that it's able to rest on the underside of the water's surface as well as walk." While the specific species of beetle hasn't been identified, the researchers believe it belongs to the Hydrophilidae family of beetles, commonly known as water scavengers.

Sharp size reduction in dinosaurs that changed diet to termites

Dinosaurs were generally huge, but a new study of the unusual alvarezsaurs show that they reduced in size about 100 million years ago when they became specialised ant-eaters. The new work is led by Zichuan Qin, a PhD student at the University of Bristol and Institute of Vertebrate Paleontology and Paleoanthropology in Beijing. He measured body sizes of dozens of specimens and showed that they ranged in size from 10-70 kg, the size of a large turkey to a small ostrich, for most of their existence and then plummeted rapidly to chicken-sized animals at the same time as they adopted a remarkable new diet: ant-eating. The alvarezsaurs lived from the Late Jurassic to Late Cretaceous (160 to 70 million years ago) in many parts of the world, including China, Mongolia, and South America. They were slender, two-legged predators for most of their time on Earth, pursuing lizards, early mammals, and baby dinosaurs as their diet. "Perhaps competition with other dinosaurs intensified through the Cretaceous," says Prof Michael Benton, one of Zichuan's supervisors, at Bristol's School of Earth Sciences. "The Cretaceous was a time of rapidly evolving ecosystems and the biggest change was the gradual takeover by flowering plants. Flowering plants changed the nature of the landscape completely, and yet dinosaurs mostly did not feed on these new plants. But they led to an explosion of new types of insects, including ants and termites." This restructuring of ecosystems has been called the Cretaceous Terrestrial Revolution, marking the time when modern-style forests and woodlands emerged, with diverse plants and animals, including insects that specialised to pollinate the new flowers and to feed on their leaves, petals an d nectar. A key problem with many alvarezsaur specimens, especially the chicken-sized ones, was to be sure they were all adults. "Some of the skeletons clearly came from juveniles," says Dr Qi Zhao, a co-author and an expert on bone histology, "and we could tell this from sections through the bone. These showed the ages of the dinosaurs when they died, depending on the number of growth rings in the bone. We were able to identify that some specimens came from babies and juveniles and so we left them out of the calculations."

Male Dragonflies Lose Their "Bling" in Hotter Climates

Less pigmentation keeps them cool, but could make it difficult to find a mate. A study in the Proceedings of the National Academy of Sciences led by Michael Moore at Washington University in St. Louis finds that dragonfly males have consistently evolved less breeding coloration in regions with hotter climates. "Our study shows that the wing pigmentation of dragonfly males evolves so consistently in response to the climate that it's among the most predictable evolutionary responses ever observed for a mating-related trait," said Moore, who is a postdoctoral fellow with the Living Earth Collaborative. "This work reveals that mating-related traits can be just as important to how organisms adapt to their climates as survival-related traits," he said. Many dragonflies have patches of dark black pigmentation on their wings that they use to court potential mates and intimidate rivals. "Beyond its function in reproduction, having a lot of dark pigmentation on the wings can heat dragonflies up by as much as 2 degrees Celsius, quite a big shift!" Moore said, noting that would roughly equal a 3.5 degrees Fahrenheit change. "While this pigmentation can help dragonflies find mates, extra heating could also cause them to overheat in places that are already hot." The researchers were interested in whether this additional heating might force dragonflies to evolve different amounts of wing pigmentation in different climates.

Conservation concern as alien aphid detected on Kangaroo Island

Photo: S. Kakko & S. Petit

An invasive species of aphid could put some threatened plant species on Kangaroo Island at risk as researchers from the University of South Australia confirm Australia's first sighting of *Aphis lugentis* on the Island's Dudley Peninsula. It is another blow for Kangaroo Island's environment, especially following the Black Summer bushfires that decimated more than half the island and 96 per cent of Flinders Chase National Park. Collected by wildlife ecologist Associate Professor Topa Petit and identified by colleagues from the WA Department of Primary Industries and Regional Development, the black aphids were found feeding on seedlings of *Senecio odoratus*, a native species of daisy, commonly known as the scented groundsel. Of 16 native Senecio species on the island, at least ten are of conservation concern. Originating from North America, the sap-sucking black aphids have spread across multiple continents over the past 20 years. This first record of the pest in Australia. Assoc Prof Petit says the alien aphid species could threaten plants in the Compositae (daisy) family.

The 2021 Brood X Cicada Emergence: A Recap

Well. That whole cicada thing was quite the fuss, wasn't it? If you missed it a couple months back, a simple recap: The world's largest emergence of periodical cicadas occurred this spring in the mid-Atlantic and eastern Midwest regions of the United States, with billions of them rising from the earth after a 17-year wait, making a bunch of noise, mating and reproducing, then swiftly dying. It all started in April and was over by the end of June. What's left of them now are their eggs, which will hatch this summer (or already are in some places), at which point the nymphs will make their way back underground to bide their time until 2038. It was a bonanza. For the cicadas themselves, for the birds and other animals that gorged on them, for the citizen scientists who observed them, for the media outlets and social media influencers that rode the wave, and—of course—for the professional entomologists who study them. *Entomology Today* caught up with several entomologists who were busy with Brood X this year to get their thoughts on what they saw, what new discoveries may arise from data gathered during the emergence, and how this go-round compared to the last one in 2004.

Fire ants found to create 'appendages' on self-made rafts when put in water

A team of researchers at the University of Colorado has found that fire ants can create 'appendages' on the rafts they make out of their own bodies when they find themselves in water. In their paper published in the *Journal of the Royal Society Interface*, the group describes their study of the behavior of fire ants in water and what they learned. Prior study of fire ants has shown them to be very highly organized when they swarm—they have been seen to use their own bodies as building material, for example, when the need arises. To do so, they grip each other with both claws and jaws, making their structure strong. Prior research has also shown that fire ant groups can behave as either a solid or liquid as they move through an environment. In this new effort, the researchers have found that fire ants can also alter self-made rafts to suit their purposes when dunked into water. To learn more about how fire ants behave when dumped into water, the researchers collected a mass of them and then dropped them into a large tank of water in their lab. Close observation of the ants showed that, as expected, they clumped into a floating circle around a rod protruding from the center of the tank forming a raft from their own bodies. But then, over time, the ants changed the shape of the raft—arms began to form, like a starfish. As they continued to watch the ants, the researchers found the little creatures changed the shape of the raft continuously with some arms being retracted and new arms forming. They suggest the arms were formed as appendages—the ants were attempting to use them to find dry land.

Butterflies and moths have difficulty adjusting to a rapidly changing climate

Climate change exerts great pressure for change on species and biodiversity. A recent study conducted by the University of Helsinki and the Finnish Environment Institute indicates that the few moth and butterfly species (Lepidoptera) capable of adjusting to a changing climate by advancing their flight period and moving further north have fared the best in Finland. In contrast, roughly 40% of Lepidoptera species have not been able to respond in either way, seeing their populations decline. Climate change is bringing about rapid change in Finnish nature -- can species keep up with the pace? Adjusting to climate change can manifest through earlier phenology such as moth and butterfly flight periods, bird nesting, or plant flowering taking place earlier than before. Species can also adjust by shifting their range further north, as individuals relocate to new areas where conditions have become favourable. The researchers emphasise that, to preserve biodiversity as climate change intensifies, it is of utmost importance to ensure sufficiently extensive, interconnected and habitats of high-quality which make it possible for species to adjust to the challenges generated by climate change.

As climates change, prepare for more mosquitoes in winter

In many parts of the world, mosquitoes are a common summertime nuisance. But in places on the front lines of climate change, these disease-spreading insects may one day be a year-round problem, according to new research from the University of Florida. "In tropical regions, mosquitoes are active all year, but that isn't the case for the rest of the world. Outside of the tropics, winter temperatures cause mosquitoes to go into a kind of hibernation called diapause. We call these mosquitoes 'cold bounded' because their activity is limited by these lower temperatures," said Brett Scheffers, senior author of the study and an assistant professor in the UF/IFAS wildlife ecology and conservation department. "However, with climate change, we expect summers to get longer and winters to become shorter and warmer. What will that mean for those cold bounded mosquitoes? How will they respond?" Scheffers said. To help answer those questions, the study's authors conducted experiments with mosquitoes collected in and around Gainesville, a North Central Florida city on the dividing line between subtropical and temperate climates. Their study is published in the journal "*Ecology*."

What does it take to discover a new species of cicada?

The 17-year cicadas emerging dramatically by the billions in 15 U.S. states from Georgia to New York and west to Illinois are making quite a racket -- a uniquely North American phenomenon -- but thousands of other cicada species on the planet also spend most of their lives underground, many of them emerging below the radar of human perception. Because most cicada species don't emerge simultaneously like species in the genus *Magicicada* -- the periodical cicadas -- little is

known about their natural history. Driven by unusual attention to detail and curiosity, Annette Aiello, staff entomologist at the Smithsonian Tropical Research Institute (STRI) in Panama, joined a very select group of people who have successfully reared cicadas a feat that may reveal their host plants, their reproductive timing and other mysterious facets of their nature -- and in this case, may result in the identification of a new species. According to published records, only three of the many hundreds of cicada species in North, Central, and South America had previously been reared from egg to adult.

New beetle species discovered and named after iconic sci-fi heroines

The original Star Trek television series took place in a future when space is the final frontier, but humanity hasn't reached that point quite yet. As researchers like Michigan State University entomologists Sarah Smith and Anthony Cognato are reminding us, there's still plenty to discover right here on Earth. Working in Central and South America, the duo discovered more than three dozen species of ambrosia beetles -- beetles that eat ambrosia fungus -- previously unknown to science. Smith and Cognato described these new species on June 16 in the journal *ZooKeys*. The Spartans also selected an unusual naming theme named in deference to the female beetles who have helped their species survive and thrive by boldly going where they hadn't before. Many of the new species are named for iconic female science fiction characters, including Nyota Uhura of "Star Trek"; Kara "Starbuck" Thrace from the 2000s "Battlestar Galactica" TV series; and Katniss Everdeen from "The Hunger Games" books and movies.

New evidence links insect population collapse to dams

Insects are the most numerous group of animals on the planet. There are an estimated 5.5 million species, 80% of which remain to be discovered. Yet insects are experiencing steep, widespread declines across the world: a "death by a thousand cuts" because of human activity. Insects perform almost every role imaginable in an ecosystem, including pollinating crops, keeping pests under control, and acting as food for other animals. The potential consequences of their decline are so dire that it has been dubbed the "insect apocalypse." Following the flurry of attention this impending environmental catastrophe generated, a more complex picture has emerged—with one gap in our understanding glaringly clear. Despite tropical and subtropical regions housing an estimated 85% of Earth's insects, what is happening in those regions is critically understudied. Understanding insect decline requires long-term datasets, which are rare, especially from the global south. In our new study, we present one of the most comprehensive known datasets of subtropical freshwater insects, spanning 20 years. What we found were pervasive declines in insect numbers across all examined aquatic insect groups, including midges, mayflies and dragonflies. Declines occurred in channels, lakes, rivers and backwaters across one of South America's largest freshwater systems, the Paraná River floodplain. In parallel, we found that numbers of invasive fish increased and water chemistry became more imbalanced—environmental changes all linked to the construction of dams.

Photo Corner

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

Eucalyptus galls caused by *Apiomorpha variabilis* (Family Eriococcidae) on blackbutt (*Eucalyptus pilularis*) at Garrawarra Farm, Royal N.P., Sydney (photos mostly by Garry Webb but some pinched from the internet)

These large galls are egg shaped, containing a female *Apiomorpha* which may live for up to 5 years. The males are winged and service her through the tiny entrance hole at the base. This same entrance hole allows young nymphs to disperse and ants to enter and harvest honeydew. The ants are the mighty protectors from parasitic insects. Once she dies, the ants may utilise the gall as a nest or temporary biouac.

Further reading:
https://www.brisbaneinsects.com/brisbane_softbugs/LargeGumtreeGall.htm
https://www.brisbaneinsects.com/brisbane_softbugs/Eriococcidae.htm
https://en.wikipedia.org/wiki/Apiomorpha

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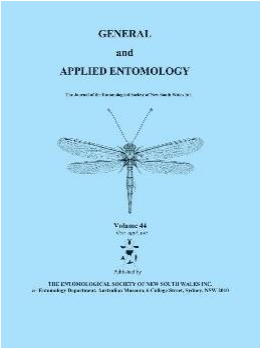

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