RCH Alumni

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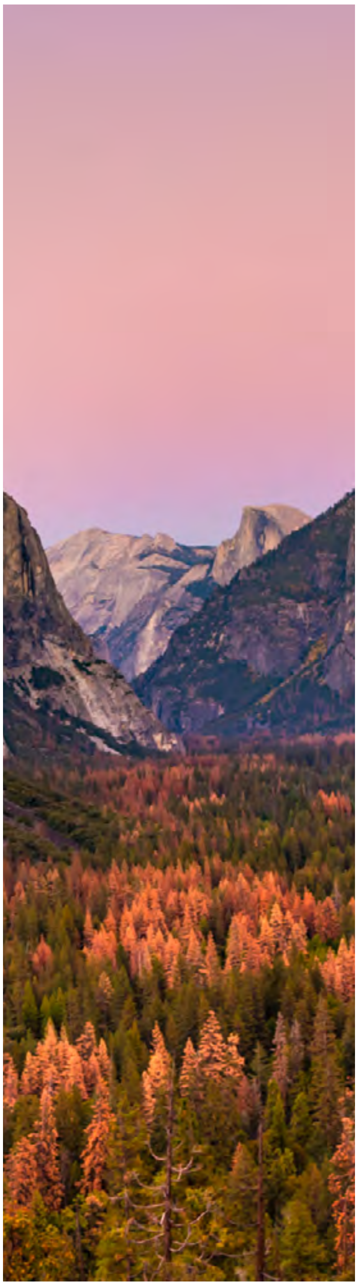
July 2021 | In this issue:

The wonderful world of ants

Photo: False Fall at Tunnel View (Gigi Williams)



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Cover image – False Fall at Tunnel View

Gigi Williams was fortunate to be a Finalist in the Plants & the Planet category of the The International Garden Photographer of the Year competition, run by the Royal Botanic Gardens (UK) in partnership with a number of organisations including the National Trust and the Royal Photographic Society.

Gigi explains her 'False Fall at Tunnel View' image: "Tunnel View is a classic Ansel Adams viewpoint. This was our second visit to Yosemite and we were shocked to see the trees dying, caused by a combination of an extended drought and an infestation of bark beetle.

"Drought ravages the natural defences of these Pinus ponderosa (ponderosa pine) trees, providing an opportunity for the bark beetle to attack. Over 2.4M trees were dead within about 131,000 acres as a result. Once again, we could see climate change in action – speeding up natural disasters".

Credits

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The 2021 RCH Alumni Executive

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Vice-President and Treasurer	Jim Wilkinson AM
Honorary Secretary	Caroline Clarke
Membership Coordinator	Garry Warne AM
Co-opted members	Kevin Collins
	Bronwyn Hewitt
	Christine Unsworth AM
	Gigi Williams

Greetings from the President

Ruth Wraith OAM

This edition of Aluminations is being prepared as Melbournians experience their fourth coronavirus induced lockdown and await news of the trajectory of the Delta variant.

It is now fifteen months since the start of the first lockdown in March 2020 and in the intervening period the Executive have continued to adapt Alumni activities to the prevailing circumstances while maintaining the core business of the Association.

At the most recent Executive meeting we flagged the possibility, indeed hope, that shortly we would be able to re-commence our valued face to face (F2F) lunch meetings at RCH. The success of Aluminar zoom meetings over the last year has led us to investigate the possibility of recording them to enable the participation of members who are not able to be physically present.

Due to the current circumstances the forum for the AGM in November, in person at the Kew Golf Club or via Zoom as last year, remains to be determined.

Activities of the Executive over recent months include the final stages of the Turning Points Project, liaising with Professor Glenn Bowes and Jacky Healy on the Melbourne University Faculty of Medicine – RCH 150 Project 'Looking Forward Looking Back', and planning for the joint Children's Rights International medico legal seminar.

Administrative matters in train include clarifying the process for RCH Library access, investigating requirements for Public Liability, establishing an Alumni Association street address and logo, and alerting eligible staff about Alumni membership.

On your behalf I would like to thank each Executive member for their ongoing commitment to the Alumni in these difficult times when some have also experienced challenging personal circumstances.

Our warmest wishes to all Alumni.

Keep safe and warm as winter deepens.

Ruth Wraith OAM is President of the RCH Alumni. View her full profile

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Joshua Tree

by Gigi Williams – image on following page

The International Garden Photographer of the Year competition is run by the Royal Botanic Gardens (UK) in partnership with a number of organisations including the National Trust and the Royal Photographic Society.

This year it attracted over 20,000 entries worldwide. The exhibition of all the winners is currently touring Europe, including Cambridge Botanic Gardens and Blenheim Palace.

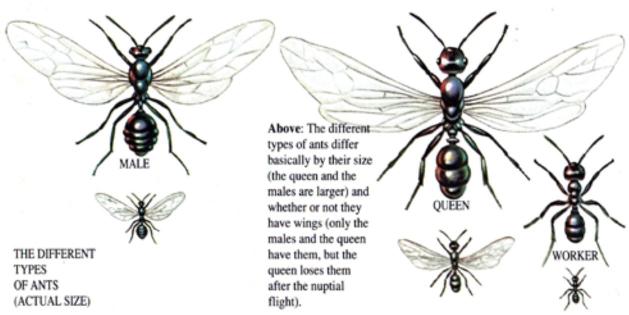
Gigi received a commendation for this image in the Trees, Woods & Forests category. She says, "This wild Yucca brevifolia (Joshua tree) really stood out to me from the desert, and to make it even more dramatic I used an infrared converted camera to make the sky darker and the foliage lighter".

The wonderful world of ants

Jim Keipert

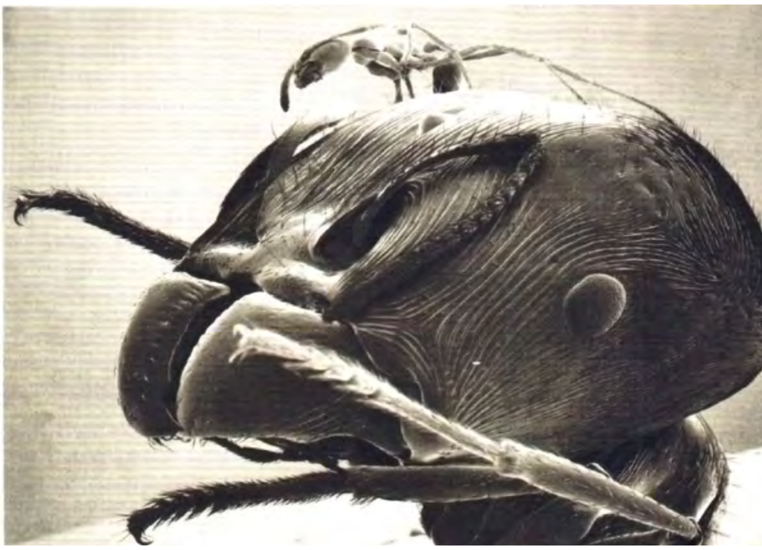
Ants are members of the insect family Formicidae – order Hymenoptera – meaning membranous wings. Ants first evolved 100 million years ago and have since diversified enormously. With 14,000 described species, and perhaps as many still awaiting discovery, they have colonized every habitable continent and almost every conceivable state. There are 100 trillion in the world.

They vary enormously in size, as shown in this diagram:



Above: The different types of ants differ basically by their size (the queen and the males are larger) and whether or not they have wings (only the males and the queen have them, but the queen loses them after the nuptial flight).

But the maximum variation of about 30:1 in length is better shown on this boot and sock of someone who walked on a trail of ants (bottom left corner) but there's a 500-fold difference in body weight between this major and minor marauder ant.

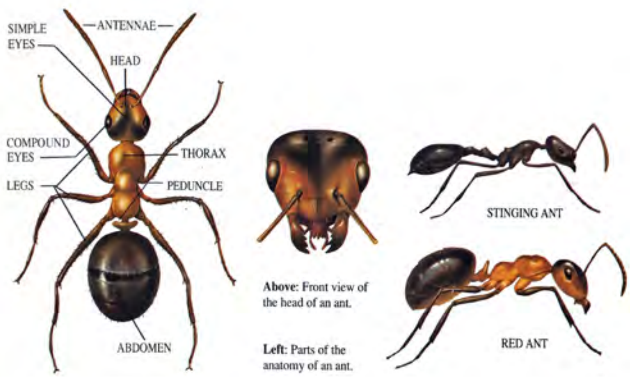


The smallest are the leptanilline ants, which are very rarely encountered. They are possibly the most primitive ant in existence, but despite being less than 1 millimetre in length, they are formidable hunters. Packs of these Lilliputian creatures swarm in search of venomous centipedes which are much larger than them, but which form their only prey.

When your only food is venomous and much larger, you're living on the edge.

The largest ant known is the bullet ant which is 25 millimetres in length and inhabits the neotropics of South and Central America. They have the most painful sting in the world.

Ants are more common in hot climates. They are social in habit and live together in organized colonies.



Above: Front view of the head of an ant.

Left: Parts of the anatomy of an ant.

Ants have a largish head. The mouth has two sets of jaws. The large outer ones move sideways. They are used for biting, fighting, digging and carrying.

They can carry fifty times the weight of the ant, equivalent to me carrying a front-end loader.

The inner pair is used for chewing, mainly to extract fluid and soft food.

Antennae arise from the front of the head – used for touch, smell and taste.

Eyes on the side of the head have good field of vision but poor acuity.

The throat is joined to the head by a narrow neck. Six legs arise from the thorax. They have three sections joined to a long foot at the end of which are two hooked claws helping the ant to walk upside down.

The thorax is joined by a thin joint to the abdomen with the petiole protruding. The abdomen contains a storage stomach – like a crop – a food stomach and intestinal tract.

The body is encased in a thick exoskeleton which protects the ant from injury and prevents loss of water from the body.

Most ants live in nests which are mainly located in the ground – a few are in trees – but may be under a rock or built above ground in a mound made from soil, gravel and twigs.

We see tiny eggs, bigger larvae and pupae inside cocoons.

The nests are damp with many hallways and rooms. In the bottom chamber the queen is laying eggs.

On the left eggs are changing into larvae being nourished by worker ants. These change to very immature pupae – or nymphs – which spin a cocoon around themselves from which mature ants emerge in three weeks.

At certain times of the year, many species produce winged males and queen. They fly into the air where they mate.

The male dies soon after, which seems a harsh penalty for a legitimate bit of hanky panky or procreation – whichever way you wish to view it, and a retrograde evolutionary step from the masculine viewpoint.

There are three casts of ants – queens, workers and soldiers – and they are all female.

To the male readers I say rejoice that we're living now. After 200,000 years of human evolution, the males – albeit precariously – are clinging onto power, but perhaps we mere males are deluding ourselves.

After 100 million years of evolution – 500 times longer than humans – the ants have opted for female dominance, so it's not hard to see which way the evolutionary wind is blowing. And I've previously shown that the main cause of adult male unemployment is female employment, so females are moving up.

Ants intended to be queens are fed special foods when young so they will produce eggs. The queen then tries to establish her own colony by digging a nest in the earth, laying eggs who will hatch as workers and take over the care of the nest, but only 1 in 500 succeeds in establishing a new colony.

The queen lays eggs varying in number from 400 to 200 million per annum and lives for between 3 months and 5 years.

We've seen worker ants at their useful work in the nests, but this shows two workers in combat over food with the worker on the right cheating by appearing larger than she is by standing on a pebble.

An Argentine ant grabbing the leg of a fire ant to control the dead grasshopper they're standing on. The fire ant is exuding a drop of poison from her stinger, to slash across her attacker.

Here a worker repelling a scorpion in a hollow log occupied by the colony, while a larva feeds on a springtail.

The soldier ants are larger and stronger females who defend the colony. These African army ants would scare the hell out of any innocent insects, but could also repel spiders and centipedes.

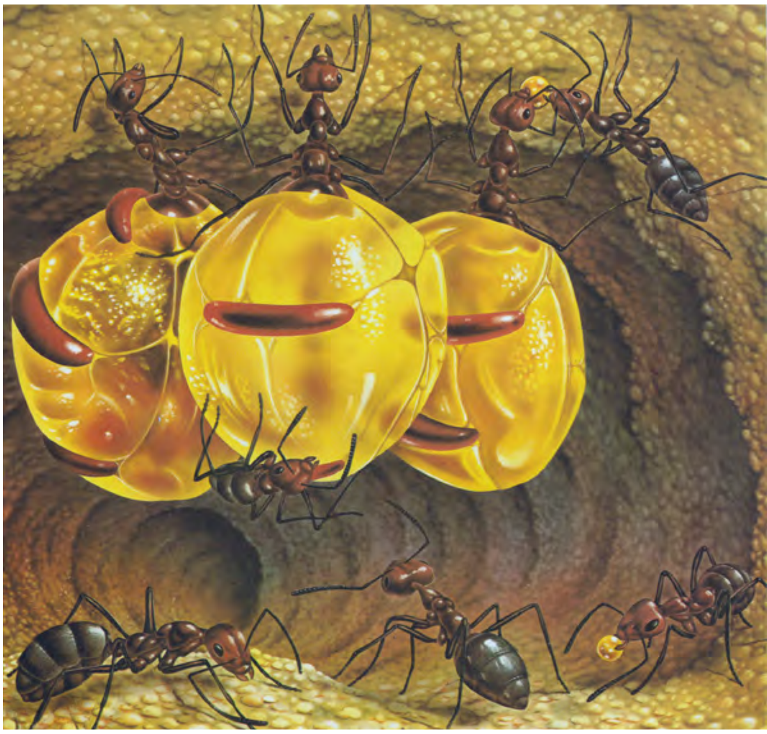
Food

Larvae are given liquid food by worker ants to allow them to grow into pupae which hatch as infant ants and are still fed by workers until they can feed themselves. The larvae are kept clean by workers to remain healthy.

Ants are omnivorous, eating both animal and plant food. They collect more than 90% of dead bodies that can be transported in the region. Scientists have counted 102,000 insects carried back to a wood ant nest in an hour.

Three ants were able to carry this dead centipede back to the nest.

They even capture caterpillars and beetles.



Bottle workers store in their abdomens a sweet liquid which they feed their companions.

The social behaviour of ants, along with that of honeybees, is the most complex in the insect world.

My interest in ants was initiated by observation of the small black ants in our garden. They are common in urban gardens and streets, and often invade the kitchen a day or so before the onset of rain. I've known them as sugar ants but their correct name is Monomorium minimum. They are about 3 mm in length and under magnification – which is difficult because they're mostly in a state of perpetual motion – they have the same structure of ants previously described.

I observed a procession of ants emerging from a section of garden east of the swimming pool and marching across concrete and then along the norther edge of the swimming pool. The concrete edge is semicircular with the edge overlying the water.

The ants walked along this edge rather than on the flat top away from the water, as though preferring to live on the edge, as it were. They then traversed more concrete, turned left along the edge of a lawn, and then raced 3 metres up a pole supporting the portico leading to the front door.

By a very circuitous route – which took me a long time to discover – they entered a horizontal pipe running above the portico and embedded in wood supporting the roof of our carport and sitting on a large concrete pillar.

I had to get into a slightly dangerous position atop a ladder. I wanted to dismember the roof of the carport sitting on the stone pillar to find the ultimate destination of the ants, but Lois said "Not over my dead body!" and the "my" part of the dead body obviously didn't refer to her.

Sitting on top of the concrete support was a piece of rotting wood – happily not weight-bearing – from which when I tapped it with my finger a number of soldier ants ran angrily out looking for a predator, but when none was apparent, retreated.

On all parts of the trail there were an approximately equal number of ants going both ways and sharing the same trail. The majority going in opposite directions make contact with each other. It's only a brief touch, but each ant has a very large number of touches during each journey.

It seemed that it would make for much easier travelling if the ants had a two-lane highway as exists for cars, but I presume there must be some evolutionary benefit for the ants to persist with what seems to be a great time-wasting behaviour. I've since found they're exchanging information with this contact with their antennae.

I found it difficult to ascertain the purpose of the enormous expenditure of energy shown by the ants on the trail, as with rare exceptions they did not appear to be carrying or transporting anything, but in view of the great degree of organization known to exist in ant colonies it would be very surprising if there were not some very good reasons for all this activity. My best guess is that the ants were carrying something, but it was too small for me to see.

The principal tools ants use in guiding their movements or actions are potent chemical signals known as pheromones. They are so pervasive and sophisticated in coordinating actions among ants, that it's appropriate to think of ants as speaking to each other through pheromones.

Around 40 different pheromone-producing glands have been discovered in ants, and although no single species has all 40 glands, enough diversity of signalling is present to allow for the most sophisticated interactions.

The fire ant uses just a few glands to produce 18 pheromone signals, yet this number, along with 2 visual signals, is sufficient to allow its large and sophisticated colonies to function.

Pheromone trails are laid by ants as they travel and along well-used routes these trails take on the characteristics of a superhighway. From and ant's perspective they are a 3-dimensional tunnel perhaps 1 cm wide that leads to food, a garbage dump, or home.

The chemicals used to mark such trails are extraordinarily potent. Just 1 mg of the trail pheromone used by some species of ants to guide workers to leaf cutting sites, is enough to lay an ant superhighway 60 times around the earth.

Some experiments and observations I've made on the pheromone trail

Rubbing finger across the trail stops passage of ants for a short time. You can do it with your sugar bowl. By repeatedly rubbing your finger around the edge of the bowl you could keep the ants out of your sugar.

Water on the trail. Ants won't enter a pool of water although an occasional ant will cross a small pool if they're travelling fast by the force of their velocity.

Ants reticent to enter a damp area. If they do, they usually exit quickly.

Wet area across the trail (not a pool).

- 2-3 cm wide – temporary confusion but rapid recovery
- 5-6 cm wide – stops passage of ants for at least several minutes
- 25 cm wide – great confusion with prolonged holdup until they find the pheromone trail on the other side of the damp area.

The effect of rain

- Rain sufficient to wet ground: ants disappear
- 11 mm overnight. No ants in morning but back in force from midday.
- 18 mm steady rain overnight – same result

  19 mm in one day – no ants out while raining, few ants out next day, but wandering aimlessly, sometimes in circles, not getting anywhere – lost pheromone trail.

The effect of hail

(it was serendipitous that I coincidentally made the following observation on the day before a big hailstorm):

5/3 Highest numbers and activity I've seen for a long time, especially around base of pole and going up pole – almost frantic activity

6/3 Only occasional and languidly moving ant out. Fortunate because at 3:30PM hail storm with golf ball sized hail stones for 20 minutes.

7/3 Frenetic activity again as for the day before hail storm.

17th and 24th January 2010. Hardly any ants out at all for no explicable reason until I realized it was the sabbath.

Effect of temperature

On the 3 consecutive days with temp >43 deg and one of 42 deg no ants.

On one day with temp 42 deg ants emerged from 6PM.

Astonished to find active as ever on Melbourne's hottest day, even with temp of 46.4 deg.

After obliteration by rain, trail sometimes re-laid in previous place, but over course of a year a number of different trails laid.

Sometimes no cause for loss of trail. One day instead of galloping 300 cm up the pole, the ants couldn't get any higher than 30 cm – they wandered in a confused manner and came down. One ant dashed up 100 cm but then seemed very surprised with his virtuosity, became confused and came down.

They're such busy creatures I thought they'd have 24-hour shift work but I didn't find any out after 11PM.

Later in my period of observation, some of the trails passed holes in the concrete between flagstones – a few mm in diameter – into which ants went and out of which they came often carrying a small white lump on their pincers. They don't make much contact with other ants, I presume because (1) got a job to do – don't want interruptions, (2) and I suppose it's obvious to ants going in the opposite direction that the other ants are bringing food back to the nest from a food source, (3) the lump would make it difficult for antennae to make contact.

Problems with lumps being carried:

- Ant going up the post carrying a larger spherical body than usual struggling. Had to stop frequently. One ant helped by pushing him but shortly gave up, while many ants hurtled by. At the top couldn't fit in a crevice to get to the next level. Had 3 ants trying unsuccessfully to help – pushing and pulling. Cleverly went sideways around the obstruction to the next level.
- Another ant going up the post had a floating pink balloon-like structure. It was hard to carry and manipulate and often got turned around by down-going ants. Then had to carry it up backwards until he could get enough momentum to turn it around and go up frontwards again. Looked like he was going to – or rather coming home from – a party.

Ants managed the same speed whether walking vertically or horizontally. The best speed I timed was 66 cm in 5 seconds. This is equivalent to 792 cm per minute, which equals 47,520 cm/hour or approximately 0.5 km/hr. This speed is approximately 1/10th that of an average human's walking speed. An immediate assessment might suggest that the ant is dawdling but several factors would negate this assumption.

1. The ant can achieve this speed going up a vertical face
2. The length of the ant's leg is only a few millimetres compared with my – and I'll be grateful if you will all regard this as highly confidential information known only previously by my tailor – my inside leg measurement of 85 cm. This means that the average human leg length is about 3,500 times longer than the ant's. If we make what I think is a reasonable assumption that the length of the leg approximately correlates with the length of the stride, then the ant is taking about 3,500 strides for one of the human. I think therefore that the ant is making comparatively superhuman speed.

Another wonder is the ant's stamina and endurance. The distance from where the ants started their migration from the garden to reaching the post was 20 metres. The vast majority of ants did not stop during this journey. This is equivalent to a human walking for a distance of 70,000 metres (70 Km) without stopping. This is a feat which could be accomplished by the occasional human, whereas all the ants do it. It is acknowledged that humans can run a marathon of 42 Km but this is an achievement attained by a select few of the human race.

The ant's performance is all the more remarkable when we note that over their 20 metre journey they don't eat or drink – they don't deviate to the pool, perhaps they prefer fluoridated water to chlorinated – so they are covering what would be the equivalent distance for a human of 70 Km, at high speed without stopping and without food or water. What a coup for industry if it could harness ant power.

I found an even more impressive performance in Mary Street, a few streets up from our house. The trail emerged from a crack in the concrete gutter, went 5 metres up the gutter, crossed the footpath – dangerous exercise – continued west adjacent to front fences, crossed the footpath in Elizabeth Street and disappeared in a think kikuya nature strip. The ants were moving in their usual rapid – almost frantic – pace for a distance of 68 metres. That's really upped the ante as that would be the equivalent for a human of 238 Km.

Another feature of ants is their ability to cross channels with vertical walls 3 or 4 times the height of the ant without slowing pace. This is equivalent to a human crossing a channel with vertical walls 17 to 24 feet high without reducing speed.

I also dropped an ant from a height of 45 cm – equivalent to approximately 180 times its height or 115 times its length – or equivalent to dropping a human from a height of 33 metres. The ant just walked away – or really (and quite sensibly) ran away.

Ants can swim. I saw what I thought was a very active insect swimming in the pool. I put a leaf under it and lifted it out and found it was really 3 ants. I got them to move from the leaf. One was presumably confused because he moved about 20 cm from the leaf and then came back and settled on the leaf. Perhaps he wasn't really confused at all but felt that the leaf was his life support system or his saviour. One ant was moving much slower than the others and was still doing so after 1 5 minutes observation – I presume he was partially drowned – or perhaps hypothermic.

I finally found where the ants went when they headed east into the garden. They went 4 metres through the garden, up a post, trekked along the edge of the decking, traversed nimbly along a rope tethering a banksia rose to the decking, and then disappeared again into the garden. No doubt, they are continuing eastward on their merry way. For all I know we may be a mere trading post on the route from Port Melbourne to Glen Iris or even Dandenong.

In March 2009 Professor Tim Flannery published an article titled 'The civilized world of the ant colony'. This was a review of a book The Superorganism: The Beauty, Elegance and Strangeness of Insect Societies, by Holldobler and Wilson.

In this section I shall quote excerpts from that article interspersed with some observations of my own.

There are parallels between ants and humans

Ants talk to each other in various ways.

- By touching and stroking with their antennae.
- With sounds they make by rubbing their exoskeleton with their legs or up against some hard object
- By their pheromones or chemical odours using between 10 and 20 chemical words or phrases.

Ants help each other. The crop is the first and upper part of the stomach where ants store liquid food. When an ant is hungry and doesn't have any food, it touches a worker's head with its antennae. The worker spits up food from its crop and passes it to the hungry ant's mouth. It can feed up to 8 other ants from a full crop.

Ants act as Good Samaritans to the disabled. Many passing ants will touch or massage a disabled ant with its antennae as though to revive it, or will sometimes try to push the disabled ant along. Will often do the same with dead ants.

Ants can be warlike creatures and will often fight with other colonies over territory or food. Some species – like humans – continue feuds for years. With a mass of driver ants raiding the ground below, this Carpenter ant tries to save itself by retreating up a grass stalk with a pupa in tow.

Ants have enemies. Spiders, frogs, toads, lizards, birds and many insects hunt or prey on ants, but in large numbers the ants may win.

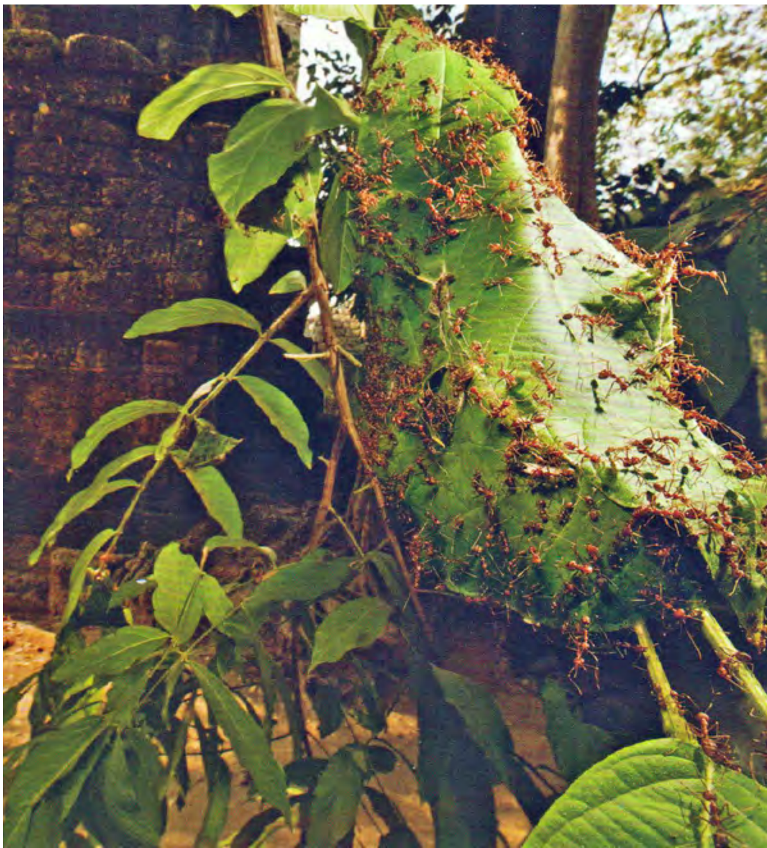
Ants protect themselves by biting, stinging with a poisonous barb at the back of the abdomen or spraying poison from the same area.

Like humans ants build houses – or nests – which also vary from the humble – a modest collection of passages or chambers – to the flamboyant – a colony of Formica Yessensis found in Japan had 306 million workers and 1 million queens living in 45,000 interconnected nests extending across 675 acres.

Also, like humans, ants improvise with the building of their houses.

Weaver ants build their nests with leaves and silk thread high in the tropical forests of Africa, Asia and Australia. Many ants hold 2 leaves with their edges in contact, while other ants very gently hold in their jaws larvae who are ready to spin silk cocoons. They rub the larvae over the edges of the leaves and the larvae spin silk to hold them together.

And here's the result:



Some ants are forced into low status jobs and are prevented from becoming upwardly mobile by other members of the colony. Garbage dump workers, for example, are confined to their humble and dangerous task of removing rubbish from the nests of other ants who respond aggressively to the odour that lingers on the bodies of the garbage workers' bodies.

But there are differences. Ant morticians recognize ant corpses purely on the basis of the presence of a product of decomposition called oleic acid. When researchers daub live ants with the acid, they are promptly carried off to the cemetery by the undertakers, even though they are alive and kicking. Indeed, unless they can clean themselves, they are repeatedly dragged off to the mortuary, despite showing every other sign of life.

Ant sex seems utterly alien. In many ant societies reproduction is the prerogative of a single individual – the queen. She mates soon after leaving her natal colony, and stores the sperm from that mating (or from multiple matings) for the rest of her life, using it to fertilize up to millions of eggs.

Some ant species do not have queen ants in the strict sense. Instead, worker ants that have mated with a male ant become the dominant reproductive individuals. These are the gamergates (the married workers) and their sex life can be brutal – sensitive male readers should abstain from reading the rest of this paragraph. In one species the gamergates venture outside the nest to attract a male, engage him in copulation, then carry him into the nest before snipping off his genitals and throwing away the rest of his body – I only hope the maligned male is in a post-copulatory coma when this grisly act takes place. The severed genitals continue to inseminate the gamergate for up to an hour, after which they are discarded. I think it is highly regrettable that the male contribution to the reproductive act is treated in such a cavalier fashion.

You might think that such an established gamergate would watch the colony carefully for signs of emerging rivals, but this is not the case. Instead, it's the worker ants that do so by taking a keen interest in the sexual status of their sisters. If they sense that one is becoming a competitive sexually active gamergate, they will turn on her, either assaulting her or watching carefully until she produces eggs, which they promptly consume. It's intriguing that the sterile workers play the role of monitoring the sexual life of the colony.

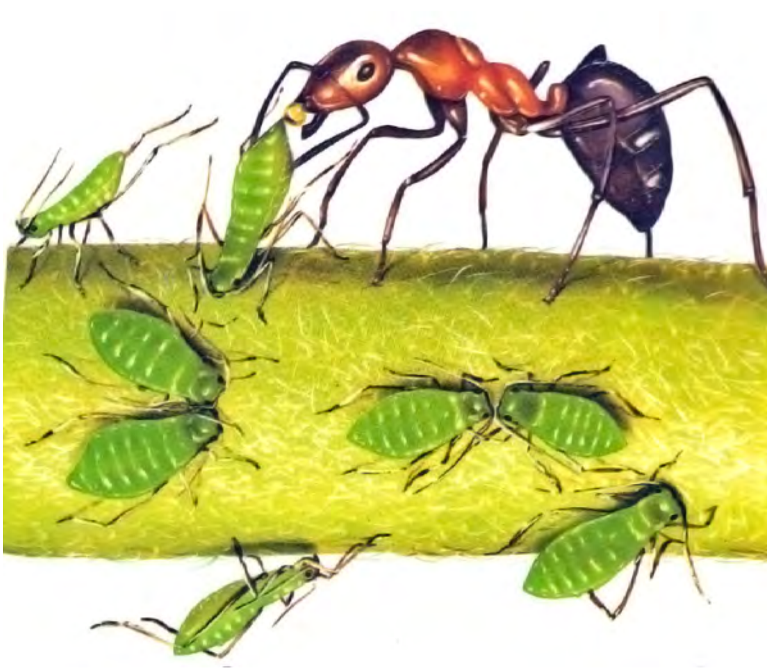
The ponerines are the most diverse of all the ant groups and are global in distribution. They cannot really be thought of as sophisticated superorganisms, for they tend to live in small colonies of a few tens to a few thousand individuals, with one Australian species living in colonies of just a dozen.

They tend to specialize in hunting just one or a few kinds of prey. That the great success of the ponerines is achieved despite their primitive social organization presents entomologists with what is known as the ponerine paradox.

It lacks a widely accepted solution, but researchers suspect that it's the ponerines' predilection to seek specialized types of prey that limits their colony size, because such specialized hunters cannot gather enough food to develop large and sophisticated colonies.

If this is the case then the very characteristic that helps the ponerines to diversify and survive in a wide variety of environments also prevents them from attaining superorganism status.

The progress of ants from this relatively primitive state to the complexity of the most finely tuned superorganisms, indicates that the progress of human evolution has largely followed a path taken by ants over a period of up to 100 million years.



Beginning as simple hunter gatherers, some ants have learned to herd and milk bugs and insects, just as we milk cattle and sheep. Aphids are small insects that suck sap from plants. They squirt out the nutrients they don't use as a sweet liquid called honeydew.

The ants milk the aphids by stroking their abdomen with their antennae and the aphids very conveniently squirt out the honeydew. In return, the ants protect the aphids from enemies like ladybirds and sometimes keep aphid eggs in the ants' nest over winter.

Malaysian ants grooming and guarding their aphids.

There are ants that take slaves, ants that lay their eggs in the nests of foreign ants, leaving the upbringing of their young to others, and there are even ants that have discovered agriculture.

These agricultural ants represent the highest level of ant civilization, yet it is not plants that they cultivate but mushrooms. They are known as attine or leaf cutters ants and are found only in the New World. The attines developed their agricultural economy 50 to 60 million years before humans sowed the first seed.

The most sophisticated of attine ant species has a single queen in a colony of millions of sterile workers that vary greatly in size and shape, the largest being 200 times heavier than the smallest. Their system of worker specialization is intricate, and recalls Swift's ditty on fleas:

> So, naturalists observe, a flea
>
> Has smaller fleas that on him prey
>
> And these have smaller still to bite 'em
>
> And so proceed ad infinitum.

The varying class sizes of attines have specific jobs to do. The larger ones cut a piece from a leaf and drop it on the ground, while others carry the leaf fragment to a depot. From there smaller ants carry it to the nest, where smaller ants cut it into fragments. The smaller ants take these pieces and crush and mould them into pellets, which even smaller ants plant out with strands of fungus. Finally, the very smallest ants, known not inappropriately as minims, weed and tend the growing fungus bed.

These minute and dedicated gardeners do get an occasional outing, for they are known to walk to where the leaves are cut and hitch a ride back to the nest on a leaf fragment.

By doing so they protect the carrier ants from parasitic flies that would otherwise attack them. Not only did the attines beat us to agriculture, but they exemplified the concept of the division of labour long before Adam Smith stated it.

The fungus formed by the leafcutter ants grows in underground chambers where temperature, humidity and acidity are precisely regulated to optimize its growth. The fungus produces a tiny mushroom grown nowhere else, and genetic studies show that various attine ant species have been cultivating the same fungus strain for millions of years, and such is their interdependence that the ants cannot live without the fungus, nor the fungus without the ants.

The system is not perfect, however, for the ant's fungal gardens are occasionally devastated by pests. One of the worst is an invasive fungus known as Escovopsis, whose depredations can become so severe that the leafcutters must desert their hard-won gardens and start elsewhere anew. Often a colony so beset evicts a smaller attine colony, taking over the premises and enlarging them to suit.

Fortunately, the ants possess a potent defence against the fungal weed that usually prevents its proliferation. Their fungicide is produced by a bacterium that is found only in pits located on specific parts of the ants' bodies, and that is known to exist nowhere else. These bacteria produce secretions that not only destroy the Escovopris pest, but promote the growth of the fungus the ants wish to cultivate.

One curious aspect of the agricultural enterprise of the attines is that the worker ants rarely eat the fungus they cultivate. Studies show that the adults gain most of their nutrition from plant sap, deriving a mere 5% from fungus.

The balance of the nutrients in the fungus is poorly suited to adult ants, but is perfect for their growing young. The mushroom gardens are thus cultivated principally for the delectation, growth and survival of the ant larvae.

When growing fungus on such a large scale, waste management becomes a crucial issue, and the attines have developed a finely tuned solution. Their sanitation teams comprise one group of workers that gathers the refuse from inside the colony and dumps it at depots outside. From there dump managers who work exclusively outside the nest carry the waste to great disposal sites far from the colony.

These dump managers are mostly older ants that have only a short time to live, which is fortunate, for the great refuse dumps at which they toil teem with pathogens and toxins.

It appears that the attines were somewhat short of the mark in providing a comfortable and peaceful old age for some of their workers.

The intelligence of the ant colony is of a particular kind. It appears that nothing in the brain of a worker ant represents a blueprint of the social order, and there is no overseer or brain caste that carries such a masterplan in its head.

Instead, the ants have discovered how to create strength from weakness, by pooling their individually limited capacities into a collective decision-making system that bears a strong resemblance to our own democratic process, but in some ways could be considered superior to it.

This capacity is well illustrated when an ant colony decides to move. With ant colonies the size, temperature, humidity and precise form and location of the chambers, are all critically important to the success of the colony.

Individual ants appear to size up the suitability of a new cavity using a rule of thumb called Buffon's Needle algorithm. They do this by laying a pheromone train across the cavity that is unique to that individual ant, then walking about the space for a given period of time. The more often they cross their own trail, the smaller the cavity is.

Some ants will choose cavities that are too large, and some too small. The cavity deemed most suitable by the majority is deemed to be the best. The means employed by ants to count votes – as it were – for and against a new cavity is the essence of elegance and simplicity, for the cavity visited by most ants has the strongest pheromone trail leading to it, and this dictates the collective decision.

Migrating ants with their larvae

The band of sisters thus sets off with a unity of purpose, dragging their gargantuan queen and all their eggs and young to a new home that gives them the greatest chance of a comfortable and successful life.

Jim Keipert, aged 98, practised as a general paediatrician. View his full profile.

The author gratefully acknowledges that many of the illustrations in this article were taken from 'Adventures among ants' by Mark W Moffett (University of California Press, 2010)

Australian paediatric icon a skilled tutor

Geoffrey Paul Davidson
January 28,1942 - December 17, 2020

Dr Geoff Davidson was a leading paediatric gastroenterologist of his generation. He cared deeply for his patients and their families, completed world-class research and was a skilled teacher of his successors.

Geoff was born in London in World War II, to Daniel and Phyllis. After the war, his father, an industrial chemist, accepted a job opportunity in Australia with a large paint company. Geoff grew up in Melbourne, attending Lloyd Street Primary and Melbourne High School.

Later, a new opportunity for his father arose in Adelaide and the family moved there in 1960.

Geoff finished high school at Adelaide High and went to University of Adelaide Medical School, winning the paediatrics prize and graduated in 1968. He then went on to train at children's hospitals in Adelaide, Melbourne and Toronto.

A modest, unassuming man with a good sense of humour, he was a determined and focused clinician, making significant contributions of enduring national and international significance. During his research fellowship at Royal Children's, Melbourne, in 1973 and 1974, he was a member of the group which discovered rotavirus, to be the single-most important cause of severe diarrhoea in young children in Australia.

Their findings were rapidly confirmed world-wide, rotavirus being estimated to cause the deaths of more than 500,000 infants each year. Along with the other members of the team, Ruth Bishop AC, Ian Holmes and Brian Ruck, Geoffrey Davidson became an icon in this field. Successful development of oral rotavirus vaccines has enormously reduced deaths and severe disease caused by this virus around the world.

When he returned to Melbourne in 1978, paediatric gastroenterology was becoming an established speciality and Geoff was appointed as the founding director later that year at the Adelaide Children's Hospital.

A visionary director, he welcomed new technology; he was a pioneer in breath testing for sugar malabsorption and became a world expert in gut motility. He reported the first cases of microvillus inclusion disease, later named Davidson's disease. He contributed to current understanding of milk allergy, inflammatory bowel disease, cystic fibrosis and coeliac disease.

He also fostered the careers of medical trainees, scientists, and fellows from around the world. Nursing initiatives did not escape Geoff's attention, helping establish the world-class first Australian Home Enteral Nutrition Service.

A prolific writer, Geoff published more than 150 peer-reviewed journal articles, wrote chapters in at least 25 scientific books and was a regularly invited speaker at national and international meetings and featured as an expert in the case records of the New England Journal of Medicine.

Geoff contributed enormously to improving the health of children around the world. This was recognised by the award of the Public Service Medal and a scholarship to honour his work by the Women's and Children's hospitals.

Geoff adored his family and was an accomplished sportsman, including running, orienteering, biking and golf. He is survived by his loving wife Marnie, and proud children Ben (an intensive care physician) and Claire (a nurse), and adoring grandchildren, Molly, Gracie, Meghan and Angus.

He was a wonderful and genuine friend to many.

Please consider a donation to the Professor Geoffrey Davidson Paediatric Research Fellowship via the Women's and Children's Hospital Foundation.

http://www.wch.sa.gov.au/support/donations/index.html

Ian Davidson is Geoffrey Davidson's brother.

Pioneer, inventor, educator: Australia's first female paediatric surgeon

Mr Richard Spicer FRCS and
Adjunct Professor Deborah Bailey FRACS

Helen Rae Noblett was a pioneering and innovative paediatric surgeon. Born in Terowie, South Australia, but brought up in Queensland, Helen made an impression at her school as a sporty, bright and hard- working scholar who won prizes and a scholarship to medical school in Brisbane.

She qualified in 1957 and proceeded to training in General Surgery and then Paediatric Surgery in Brisbane Children's Hospital under the late Des McGuckin in 1962. She was McGuckin's first Trainee.

In 1963, Helen moved to the Royal Children's Hospital, Melbourne and continued her training as a registrar under Frank Douglas Stephens AO, Edward Durham Smith AO and others. She was awarded her FRACS in 1964, becoming the first female paediatric surgeon in Australia.

During Helen's time in Melbourne, she pursued research in gastrointestinal diseases in parallel with her clinical work, working with Ruth Bishop's team (which later went on to first describe Rotavirus in 1973).

It was during this research that she invented a device for sampling ganglion cells in rats, which she later developed into the instrument for use in babies and children. It bears her name to this day.

In the United States, Helen worked as a research fellow with Bill Clatworthy and Jim O'Neill at Columbus Children's hospital from 1967-1968 and made a strong impression. Her colleagues noted that she was 'delightful, collaborative, charming, very scholarly,' 'we learned an enormous amount from her' and that 'she was the real thing'. Other Americans mention her enthusiasm, skill and kindness.

Back in Melbourne, Helen was part of the thoracic surgery unit headed by Russell Howard, which also included Nate Myers and Max Kent. Helen developed her own method for managing babies with oesophageal atresia post-operatively: at the time of repair she fashioned a gastrostomy with a trans-pyloric feeding tube to enable immediate enteral feeding without the complications of gastro- oesophageal reflux. She continued to use this technique throughout her career.

For cases with a long gap she used the reversed gastric tube, though later she was open to discussion of alternatives.

In 1969, Helen published two landmark papers. The first was a method for the non- operative treatment of meconium ileus by Gastrografin enema. Until that time, most babies were treated surgically. The second described the rectal suction biopsy device of her own invention used in the diagnosis of Hirschsprung disease. Both of these are in regular use worldwide today and associated with the name of Noblett.

In 1976, Helen left Melbourne to become the first paediatric surgeon at the Bristol Royal Hospital for Children in the United Kingdom. Bristol was one of the last major centres in the UK to recognise the need for paediatric surgery and there was opposition to the role in the entrenched views of some senior surgeons and paediatricians. However, Helen was a very strong and resilient character and within a short time she had demonstrated that her outcomes were as good as those at any centre in the country.

The next battle was to appoint a colleague but it was not until 1982 that David Frank was appointed to share the large workload and develop paediatric urology in Bristol.

It is difficult to understand how one person managed the workload generated population of four million people for six years, but she did, and to an extremely high standard.

Helen was a scholarly and cerebral surgeon. From 1976, she published 22 papers on a variety of topics and was always innovative and up to date. She served as examiner for the newly introduced Fellowship of the Royal College of Surgeons (Paediatrics).

She had little taste for managerial or administrative duties and concentrated on her patients, who were the driving force behind her extraordinary energy and stamina. Her patients and their families appreciated how fortunate they were to be under her care and spoke of her with affection and respect.

Helen had exceptional technical expertise and clinical judgement. She cherished the concept of a strong team and glowed in the company of her favourite colleagues and Trainees. She took her responsibility as a trainer very seriously and many distinguished surgeons from a variety of countries regard her as the formative figure in their careers.

There was a steely side to Helen which was apparent whenever anything threatened to interfere with patient care. Trainees described her variously as 'tough but fair', and 'a hard taskmaster' who 'did not take any nonsense', but all emphasise how supportive she was to those she assessed as sensible, competent, and hard-working. She was uncompromising and a shrewd judge of Trainees. If a Trainee did not come up to her high standards, she made sure they went into a different branch of medicine.

Away from work, Helen was cultured and sociable, warm and humorous. She could discuss art, literature and music, with Mozart a particular favourite. Her annual Christmas parties were eagerly anticipated; the food and drink were lavish, and we gathered round the piano (with Helen playing) to sing carols. Her relaxation often centred round her canal narrow-boat, 'Katkin', and she had many amusing anecdotes concerning boating mishaps to tell in the theatre coffee room between operations.

Helen Noblett deserves to be remembered as a great character and a paediatric surgeon of the highest calibre. Her legacies are her innovations in her field, the many departments around the world which she inspired, the large number of children who owe their lives to her exceptional abilities, and the large and thriving department of Paediatric Surgery in Bristol today.

Tidal River, Wilson's Promontory, May 2021. Photographer: Garry Warne

Australia's distinguished place in coeliac disease history

Coeliac disease (CD) was once thought of as a childhood illness and much of our early knowledge came from the study of malnourished children with so-called malabsorption. Here, paediatric gastroenterologist and MAC member, Prof Don Cameron, looks back at some of the key roles played by Australian medical specialists in the early days of coeliac disease.

(Figure 1) Dr Willem Dicke, circa 1957.
With permission, BMJ Publishing Group Ltd. (See Ref 1)

Australia has a proud place in the history of coeliac disease (CD), beginning with the early work of Dr Charlotte ("Charlo") Anderson, a Melbourne paediatrician known as the "Mother of Paediatric Gastroenterology". With her background in Science and Medicine, she had a particular interest and expertise in sorting out the different types of digestive problems leading to malabsorption and malnutrition in children. In those days the differences between coeliac disease, cystic fibrosis and other causes were not at all clear.

The term Coeliac (koiliakos) was first used by Aretaeus of Cappadocia in the second century. Much later,in 1888, Dr Samuel Gee in London wrote of the "coeliac affection."

He felt that diet must play a part somehow and even that it may be due to farinaceous foods (starch).

Many empirical diets were tried including mussels, bananas, even tulip bulbs, and others, but it was hit- and-miss until Dutch paediatrician

Dr Willem Dicke identified the role of wheat and rye. He was already suspicious of them in the 1930's and first published in 1941. During the terrible "Dutch Famine" of the winter of 1944/45, he famously observed that his coeliac patients improved, only to deteriorate when food supplies, notably wheat, were restored after liberation from German occupation.[1] His findings were presented in his 1950 thesis.[2] (see Figure 1)

Dr Dicke had clearly identified the role of wheat and rye, but what was it in these cereals that caused the problem? Was it the starch, was it the protein or was it something else?

This is where Charlo Anderson came in. In the early 1950's, she travelled as a ship's doctor to London, where she worked as a research fellow at the Great Ormond Street Hospital for Sick Children and then at the Institute for Child Health in Birmingham. There, she performed a series of meticulous experiments in ten children with coeliac disease, carefully measuring the amount of excess fat in the faeces while they were on different diets - a painstaking and at times less than pleasant task. She and her colleagues were able to demonstrate that gluten was the culprit and published their findings in the prestigious medical journal, the Lancet, in 1952.[3]

The Gluten Free Diet was established. Dr Anderson returned to Melbourne in 1953 and established the Gastroenterology Research Unit at the Royal Children's Hospital, where she continued to work on the problems of coeliac disease and cystic fibrosis. She reported spending many hours and days doing faecal fat tests in a very hot tin shed on the roof of the old hospital.

She was head-hunted back to Birmingham in 1968 as the first-ever female professor of paediatrics in the UK. She was a founding member of the European Society of Paediatric Gastroenterology (Hepatology) and Nutrition, well-known for developing the so-called ESPGHAN criteria for coeliac disease. In 1975 she co-edited, with Valerie Burke from Perth, one of the first comprehensive textbooks in the field. Paediatric Gastroenterology (Blackwell) went on to three editions. She is pictured in 1993 presenting a copy of the second edition to Professor

Graeme Barnes, the then director of the RCH department. (see Figure 3)

Professor Charlotte Anderson retired to Perth in 1982, returning to Melbourne in 1992 where she lived until 2002. She was honoured as a Member of the Order of Australia in 1977. We are very proud of "our Charlo" in Melbourne and Australia.

Dr Rudge Townley followed Charlo Anderson as the Director of Gastroenterology at RCH Melbourne. He had modified the Watson small bowel biopsy capsule to enable duodenal biopsies to be obtained quickly and safely from children with suspected coeliac disease and other conditions.[4,5] He was one of the first in the world to identify that coeliac disease runs strongly in families and that close family members should be routinely tested, even though it was considered largely a disease of childhood.

My interest in coeliac disease began as a research fellow with Rudge Townley in the mid-1970's, doing lots of biopsies using his capsule technique looking after many children with coeliac disease. Endoscopy and serology were not yet available and we strictly followed the ESPGHAN criteria. This meant that children were required to have three biopsies; the first while still on a normal diet; the next after about a year on the GFD to demonstrate return to normal; and thirdly, a repeat biopsy after at least six weeks back on gluten to demonstrate recurrence of the microscopic abnormalities of CD. My interest in CD was reinforced by my time at Great Ormond Street in the late 1970's and firmly established on my return to Australia in 1979.

The GFD was even tougher back then. The late Betty Lynch, then chief dietitian at RCH took a particular interest in helping families to manage the dietary requirements and she was closely involved in the very early days of the fledgling Coeliac Society. Betty died in 2019 at the age of 97, still very active. She will be remembered fondly by some of the Melbourne families affected by CD all those years ago. Betty Lynch retired from RCH in 1987 and was succeeded by Dorothy Francis, another Melburnian, who had been the chief dietitian at the Great Ormond Street Hospital for Sick Children and author of Diets for Sick Children. While in London, Dorothy was closely involved in a parents' support group that went on to become the Coeliac Society of the United Kingdom.[6]

I remember the early days of the Coeliac Society in Victoria and was pleased to be able to go along to meetings to answer questions, and to write much of the early educational material for the society. Enthusiastic volunteers, most touched by CD one way or another, organised meetings in local church halls and other venues. I do not have CD, but I always enjoyed sampling the plentiful home- made gluten-free goodies on offer at the back of the hall.

Informed by the past forty years, we know CD is much more common than previously thought and is clearly not just a childhood disease. We have greater understanding of the interaction of gluten and the immune system, without yet having found the ultimate cause. Upper gastrointestinal endoscopy (gastroscopy) has replaced the biopsy capsule; the role of HLA types DQ2 and 8 as "essential but not sufficient" is established; and serology, notably antibodies to tissue transglutaminase, has now become a mainstay of diagnosis, even in certain circumstances being used for diagnosis.[7] The development of a "vaccine" by another Anderson in Melbourne (Bob, no relation to Charlo) and colleagues has unfortunately been suspended, but the scientific work continues.

The GFD has been improved by specialist commercial products, niche producers and better community understanding, but there is still a lot to learn. The important roles of expert dietitians and the support of Coeliac Australia are invaluable.

Coeliac Australia has come a long way in four decades. It has been my great pleasure that I can still make some contribution as a member of the Medical Advisory Committee (MAC). I will leave it to others to write of the next forty years.

Prof Cameron is a paediatric and adolescent gastroenterologist who has been looking after young people with coeliac disease since the 1970's. He retired from clinical practice in late 2019 but continues to be actively involved with coeliac disease research. He has been closely associated with Coeliac Australia for many years and has been a member of the Medical Advisory Committee since its inception

(Figure 2, left) Charlotte Anderson in Melbourne, circa 1960. Image courtesy the Royal Children's Hospital Archives and Collections. (Figure 3, right) Graeme Barnes and Charlotte Anderson. 1993. Image courtesy GL Barnes and RCH Creative Services.

Prof Don Cameron is a paediatric gastroenterologist and MAC member.

Author's footnote: This is not meant to be an exhaustive history of coeliac disease in Australia. Many people have made major contributions. They know who they are.

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