The Natural News

Central North Field Naturalists Inc.

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Collembola *Neelus.* sp. Photograph by Andy Murray

The Search for the Golden Fagus (Part 2)

Paul Edwards

The falling leaves drift by the window
The autumn leaves of red and gold
Autumn Leaves: Joseph Kosma & Johnny Mercer

Autumn Leaves of Red and Gold

The story I foreshadowed in Part 1 of this two part article starts in spring when the green leaves emerge and the process of photosynthesis commences in the chloroplasts. This involves the manufacture of carbohydrates using carbon dioxide from the air and water from the soil, powered by solar energy captured by the 'antenna' pigments, the green chlorophylls and the yellow carotenoids present in the leaves which act as solar panels (HyperPhysics Website, 2005).

The young foliage appears green because these two pigments respectively absorb the red and the blue components of sunlight, leaving the dominant complementary colour (green, from the colour wheel below) to be reflected back to the eye.

The TV (RGB) Colour System showing opposite Complementary Colours (from Wikimedia commons: File RBG colorwheel.svg)

The Green Chlorophylls

The chlorophylls play a vital role in photosynthesis. Not only do they collect solar energy but they also supply the electrons that power the chemical reactions which produce the sugars, starches and cellulose needed by the growing plant. It might seem strange to introduce electrons into this biological scenario, seemingly far removed from physics and technology. However, electronic phenomena underlie all the physical and chemical processes that culminate in the reds and golds of autumn, in particular, oxidation (the loss of electrons from molecules), and reduction (their gain).

Unlike the stable carotenoids, the green chlorophylls are short-lived and need to be continually replenished by photosynthesis. However, as the days grow short, the chlorophylls fade away, leaving the carotenoids behind to colour the ageing foliage yellow.

The Gold Carotenoids

The carotenoid pigments, the yellow xanthophylls and orange carotenes, absorb light at the blue end of the spectrum. So, as the colour wheel indicates, they appear orange/yellow. The chlorophylls present in young foliage and unripe fruit usually mask these blue-complementary colours. The best known carotenoids are probably the orange carotenes in apricots and carrots, and the red lycopene in tomatoes. The yellow lutein is found in green leafy vegetables. Like the chlorophylls, the carotenoids are anti-oxidants, best known for their in-vitro antagonism to the carcinogenic free-radical oxidation products formed in animal cells. Carotenoid colours are utilised by birds & animals for signalling. They appear to serve two vital functions in green foliage. Besides assisting the chlorophylls to collect solar energy, they also protect them by absorbing potentially damaging blue and ultraviolet light.

The Red Anthocyanins

In some deciduous trees, including South American *Nothofagus* species, a third group of pigments appears in autumn. These are the anthocyanins, named for their blue colour when first isolated from cornflower petals. Unlike the carotenoids, the red, blue and purple anthocyanins are not usually present in young leaves but are photosynthesised from the sugars in the dying leaves. Their photosynthetic origin is evident from the blueberry leaf images below. Note the shadowed (yellow) and illuminated (red/purple) upper leaf surfaces; the red anthocyanin-filled veins and the un-illuminated (green) lower leaf surfaces.

Anthocyanin photo-synthesis in blueberry leaves. Canberra, June 2014.

The water-soluble anthocyanins are commonly found in flowers, fruit, sap and roots and in the veins and vacuoles of autumn leaves. They usually absorb green or cyan light and consequently appear magenta or red, the corresponding complementary colours shown in the colour wheel. Anti-oxidants, like the carotenoids, are also credited with health-giving properties. Anthocyanins readily change colour in chemical reactions. For example, red wine made from the Spanish *Tempranillo* grape variety typically has blue and purple hues owing to its high anthocyanin content and low acidity.

The red anthocyanins probably act as a light screen, protecting against tissue-damaging blue sunlight in cold autumn conditions. Although the deep orange of late autumn Fagus may not be due to anthocyanins, the rare purple Fagus leaf colour in Dennis Harding's photo in Part 1 and the magenta in Michael Gay's photo below indicate their occasional presence. In the northern hemisphere cold, bright and dry autumn weather enhances red foliage: cold weather shuts off the flow of nutrients to and from the leaves; sunny weather enhances red because anthocyanins are themselves the products of photosynthesis; and dry weather concentrates the precursor sugars in the plant saps. These may be the conditions that produce occasional bright red/purple Fagus foliage. Abnormal light exposure may also affect anthocyanin physiology: an entire row of grapevine foliage is recently reported to have turned bright red following an autumn lightning strike.

Yellow carotenoids and magenta anthocyanins in the Fagus near Lake Fenton, Mt Field NP in 2008. (michaelgayphotography.com)

Chemical analysis could settle the question of the autumn Fagus pigments. Simple paper chromatography techniques available in school science classrooms—and in the kitchen!—can separate the blue and purple anthocyanins from the yellow and orange carotenoids in late autumn leaves like the *Tempranillo* vine leaves below.

Tempranillo grapevine leaves and a "kitchen sink" paper chromatogram of their anthocyanin (upper) and carotenoid (lower) pigments. (Kayena, Tasmania, May 2014).

The Quantum Physics

Photosynthesis governs the birth, life and death of plants and their leaves. Electrons in the antenna pigment molecules capture and destroy light particles (photons) from the sun and snatch all their energy. This is the photoelectric effect, first explained in a famous paper written in 1905 by Albert Einstein.

In essence, the harvesting of sunlight energy by the molecular antennas in leaves requires a match between the energy of the incoming photons and the energies that can be absorbed by the electrons present in these molecules. Now the electrons which bind the carbon atoms together to form organic molecules behave like waves on a violin string—the longer the molecular string, the longer the electron wavelengths and the lower their corresponding energies. This violin string model of electrons in boxes earned Erwin Schrodinger the Nobel Prize for physics in 1933. It illustrates the famous Heisenberg Uncertainty Principle, named for another (1932) Nobel prize-winner, Werner Heisenberg.

Many molecular boxes are so small and their electrons are so energetic that they can only acquire energy from correspondingly high energy ultraviolet light photons. Consequently they don't appear coloured, except perhaps to the birds and the bees. However, the xanthophyll molecules in yellow leaves each contain a line of 22 carbon atoms of just the right length to allow their electrons to resonate with and capture blue sunlight photons. The more complex green chlorophyll molecular rings absorb solar energy from red and blue light. The various antenna pigments are each tuned to capture photons of specific colours. If the antenna molecules were much shorter or longer, their vibrating electron waves could not resonate with solar photons of the visible spectrum and the leaves would lose both their colour and their effectiveness as solar energy collectors. In contrast, the palette of anthocyanin colours spans the entire spectrum as the molecular boxes containing their colour-giving electrons expand and contract with changes in the chemical environment—hence their extensive use by plants.

Carotenoid and anthocyanin based compounds are evidently vital to growing plants and animals, not just incidental contributors to passing shows of autumn colour like the golden Fagus.

References
HyperPhysics Website. 2005. Georgia State University. Photon absorption for photosynthesis.http://www.hyperphysics.phy-astr.gsu.edu/hbase/biology/antpho.html (viewed June 11, 2014).

Wikipedia, Anthocyanin. en.wikipedia.org/wiki/Anthocyanin. (viewed June 11, 2014).

US National Arboretum Website, 2011. The Science of Colour in Autumn Leaves, http://www.usna.usda.gov/PhotoGallery/FallFoliage/ScienceFallColor.html, (viewed June 11, 2014).

Hoch, Zeldin and Mc Cown, Physiological significance of anthocyanins during autumnal leaf senescence, http://treephys.oxfordjournals.org/content/21/1/1.full.pdf (viewed June19, 2014).

Long, Warwick, 2014. Lightning strikes grapevines in Victoria, ABC Rural, http://abc.net.au/news/2014-04-22/lightning-vines/(viewed July 09, 2014).

Hoch, Zeldin and McCown, 2011. Find the hidden colours of Autumn leaves, Scientific American, http://www.scientific American.com/article/bring-science-home-leaf-colors/ (viewed June 11, 2014).

Koning, Ross E. 1994. Light. Plant Physiology Information Website. http://plantphys.info/plant_physiology/light.html. (viewed July 01, 2014).

The American flamingo is considered to be the most brightly colored flamingo in the world. Its diet is mainly brine shrimp, *Artemia*, which in the lagoons of Galapagos get their carotenoids by feeding on unicellular algae and protozoa. (Photo: S. Lloyd)

Scarlet Robin. The orange, reds and yellows in birds' bills, feet and feathers are usually (but not always) derived from the carotenoids they ingest in food.

Fan-tailed Cuckoo. The colour of birds can assist in species identification and can indicate the age, sex and health of an individual.

Making a Difference in an Urban Bushland

Hazel Britton and Patricia Ellison

The Reid Street Reserve comprises 2.6 ha of native bushland on a hillside overlooking the Leven estuary on the western edge of Ulverstone. It is the largest area of remnant eucalypt forest in the vicinity of Ulverstone and is now surrounded on all sides by residential development.

A management plan for the Reserve was produced by Central Coast Council in 1998 and revised in 2007. In 2011 the Council commissioned Bushways Environmental Services Tasmania to undertake a vegetation assessment and work plan. According to this publication, the Reserve is dominated by black peppermint (*Eucalyptus amygdalina*) with white gum (*E. viminalis*) co-dominant and stringy bark (*E. obliqua*) also present. Native cherry (*Exocarpus cupressiformis*) and prickly beauty (*Pultenaea juniperina*) are common understorey plants and many other native shrubs are also present including native gorse (*Daviesia ulicifolia*), erect currant bush (*Leptomeria drupacea*), blue love creeper (*Comesperma volubile*) and the white flag-iris (*Diplarrena moraea*).

While much of the bush is in good condition, it is under serious threat from many weeds, tracks, dumping of garden waste and unauthorized cutting of vegetation. Central Coast Council has been active in weed removal, particularly blackberries and Montpellier broom, over several years. In 2013 a small group of users of the Reserve who were concerned about the severity of the weed problem decided to form the Friends of Reid Street Reserve to supplement Council's work. Of the 16 main weed species in the Reserve, the Friends are focusing on bluebell creeper (*Billardiera heterophylla*, previously *Sollya heterophylla*). This weed, which is native to Western Australia, is a severe problem in the Reserve, strangling and killing eucalypt saplings and

Reid Street Reserve (Photo H. Britton)

Bluebell creeper (*Billardiera heterophylla*) strangling a eucalypt at Reid Street Reserve (Photo H. Britton) smothering other plants in the understorey. A variety of other weeds, largely resulting from the dumping of garden waste, are also being removed. They include banana passionfruit (*Passiflora mollissima*), holly (*Ilex aquifolium*), agapanthus (*Agapanthus africanus*) and forget-me-not (*Myosotis sylvatica*). Montpellier broom (*Genista monspessulana*) is another very serious problem; some large shrubs have been removed and a biological agent (a species of Psyllid) has been introduced and its effectiveness is being assessed. (see p. 13)

In spite of these problems, this little reserve provides homes for a wide variety of bird species. The eucalypt canopy is important feeding habitat for the endemic Black-headed and Strong-billed Honeyeaters and Striated and Spotted Pardalotes, all of which have breeding populations in the Reserve. Swift Parrots have been recorded feeding in the canopy when the

native gorse (*Daviesia ulicifolia*)

prickly beauty (*Pultenaea juniperina*)

blue love creeper (*Comesperma volubile*) eucalypts are in flower during their migration. The Reserve also holds several pairs of Dusky Woodswallows and the endemic Green Rosellas and Yellow-throated Honeyeaters. Golden Whistlers, Grey Shrike-Thrushes and Grey Fantails are also present and can be heard calling in the spring and summer. Three species of cuckoo, the Pallid, Fan-tailed and Shining Bronze-Cuckoos are also present at this time.

The threatened eastern barred bandicoot has been observed just outside the Reserve and is likely to occur there. Pademelons are seen within the Reserve and the bushland is likely to provide habitat for a variety of bats, reptiles and invertebrates. We hope to increase our knowledge of the fauna in the Reserve and to promote its value to the wider community.

Publications consulted

Vegetation assessment and work plan: Reid Street Reserve, Bushways Environmental Services Tasmania (October 2011); an update to 'The Birds Recorded at Reid Street Reserve' in the above publication was submitted to the Central Coast Council by Hazel Britton in November 2011.

Spotted Pardalote

Strong-billed Honeyeater

Dusky Woodswallow

Shining Bronze-cuckoo

Collembola at Black Sugarloaf

Photographs by Andy Murray

In September 2014 UK naturalist and photographer Andy Murray spent a week at Black Sugarloaf during an extended visit to Australia and New zealand to photograph collembola. Andy tracked us down through the disjunctnaturalist website on which is describe observations of collembola feeding on myxomycetes, a hitherto little known aspect of collembolan biology.

Collembola, also known as springtails, are small wingless soft-bodied hexapods (6 legged) that are usually between 1 and 3 millimetres in length although some may grow to 10 millimetres long. Their common name comes from the fact that many species can spring considerable distances when disturbed. As Andy's photographs show, collembola come in a variety of shapes, colours and textures.

Odontella sp.

Katianna sp. Male collembola generally attached a tiny packet of sperm to the substrate (left) which is picked up by a female.

Acanthanura sp. feeding on developing myxomycetes

Adelphoderia sp.

Dicyrtomina sp.

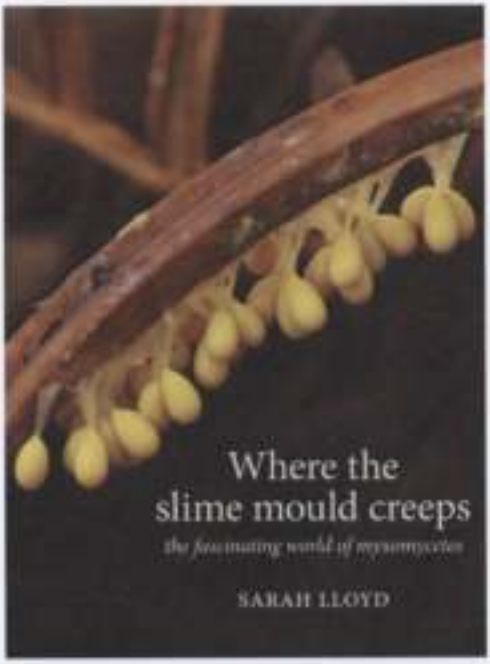
Sminthuridae sp.

Neanurinae sp.

Acanthanura sp. feeding on developing *Trichia* sp.

Book Review

Where the slime mould creeps: the fascinating world of myxomycetes by Sarah Lloyd, Tympanocryptis Press (2014), paperback, 102 pages, (ISBN 978-0-646-92451-9)
Reviewed by Tom Thekathyil, Lottah



Slime moulds would have to rank amongst the most obscure of the common forms of life on earth. Although widely prevalent in most parts of the habitable world they are rarely seen by other than the initiated, and few ever recognize what may be before their very eyes.

The best explanation for this ignorance is the paucity of literature for the beginner. Apart from a short section on myxomycetes in Fuhrer's fungi book[1] the rest of the available literature is highly technical and forbidding. There has been no widely available hand-held guide available for a complete novice to understand slime moulds.

Lloyd is to be commended for filling this vacuum by publishing what is hoped to be the first of her books on myxomycetes. I have to confess that despite having been familiar with slime moulds for several years it took a draft version of the present book to realize that the plasmodium originates from a single zygote and was not an aggregation of millions of amoeba having a corroboree of sorts.

As the author points out early on, classification of these organisms has long been confusing, variously appearing under botany as well as under zoology. Myxomycota is now accepted as falling under the kingdom Protista which includes algae (and seaweeds which are *not* plants).

I found the most useful section of the book to be Part 1 which discusses the biology of these organisms. It makes for slow reading because the unfamiliar terminology requires constant reference to the glossary. However, we have also been provided with images with superimposed text explaining the structure of the fruiting bodies. Part 2 (p. 45-62) with its informal discussion on various related topics, and the image gallery in Part 3 (p. 63-90) make for easier reading.

The book is illustrated with a large number of high quality macro- and micrographs. Despite their small size, mainly 55 x 45 mm, the details are very clear.

Having read the book I need to make a second confession, that I am still in the dark about what makes these critters tick. They lack brains but demonstrate forms of intelligence in avoiding obstacles when searching for food in a maze. Researchers have found that the optimal paths used by *Physarum polycephalum* in searching for food in contrived situations are not dissimilar to the network of roads connecting major cities in several countries. This is of course no reflection on the book, merely an observation that we are dealing with complex organisms of which we know little.

The main criticism of the book is the lack of scale for images. Something along the lines of Malcolms' *Glossary*[2] showing scale bars with caption would have been very desirable.

[Editor's note: an indication of size is included with most captions.]

Lloyd's modesty has inhibited her from revealing that one of her finds is new to science and has been named after her – *Alwisia lloydiae* Leontyev, S.L.Stephenson & Schnittler (publication pending).

This book has the promise of becoming the standard work for beginners in the same way Fuhrer's has been for fungi and Meagher & Fuhrer's has been for bryophytes[3]. Appendices provide information on classification, a glossary, bibliography and a checklist of Australian myxomycetes.

The book is available from Fullers, Petrarchs and the Devonport Bookstore, online through Fungimap or direct from the author.

References

[1]Fuhrer, B., *A Field Guide to Australian Fungi*, Bloomings Books Pty Ltd (May 2005) ISBN 1-876473-51-7

[2]Malcolm, W. & Malcolm, N. *Mosses and Other Bryophytes, An Illustrated Glossary, 2nd Edition*, Micro-Optics Press, 2006, ISBN 0-9582224-7-9

[3]Meagher, D. & Fuhrer, B., *A Field Guide to the Mosses and Allied Plants of Southern Australia*, Flora of Australia Supplementary Series, Number 20 - Australian Biological Resources Study/The Field Naturalists Club of Victoria, 2003; ISBN 0-642-56828-6

The Cape Broom Psyllid

Cape broom, *Genista monspessulana* (also known as Montpellier, French or canary broom), is a 2-3 metre tall leguminous shrub with bright yellow flowers. Native to the Mediterranean region it is now a significant weed in the higher rainfall areas of southern Australia especially in disturbed bushland and poorly managed pastures.

Its hard seed coat can delay germination with buried seeds able to remain dormant and viable for four or more years. Large seed banks exceeding 50,000 seeds per square metre can develop under mature plants. Seed dormancy is broken by fire resulting in dense infestations that can out-compete other plants.

Herbicides, burning, mechanical clearing and grazing by sheep and goats have been used to control the weed but their limited success, expense and difficulty has resulted in biological control agents being investigated.

The Cape broom psyllid, *Arytinnis hakani*, is a sap sucking bug that is abundant on Cape broom in the western Mediterranean where it can reduce flowering and leaf area. The psyllid was approved for release in south east Australia after tests confirmed that it posed no risk to native flora. It was released in Tasmania in 2009 and a mass rearing program is now being conducted by the Tasmanian Institute of Agriculture to establish it at sites throughout the State.

Females lay up to 200 eggs amongst young leaves and flower buds. After eggs hatch in spring the nymphs feed on leaves and buds. They pass through five instars before reaching the adult stage. In Tasmanian the psyllid may pass through three generations per year.

The psyllid has the potential to retard the growth, reproduction and spread of Cape broom and may provide a useful control in native vegetation.

Information from: Weed Biological control pamphlet: Cape Broom Psyllid.
Tasmanian Institute of Agriculture (TIA)

Bird observations at Birralee
Text and photos Sue Gebicki

Dusky Robin

I have very little time available for observing birds so I was thrilled when on 15 November 2013 I noticed a lot of activity at a nest built a couple of seasons ago by swallows on the front of our house. It made observation easy, and while the birds weren't overjoyed when I set up a camera tripod, they eventually settled down. The occupants were, in fact, not the swallows but a pair of dusky robins. The position was definitely prime real estate – excellent open views to watch for predators, lots of nearby landing sites, a solid roof overhead and a ready-built nest located on a sheer wall safe from rats and snakes.

17/11 One of the birds was observed to stay on the nest permanently (they may have swapped roles, it was impossible to tell as they look so alike) while the other fed the sitter. I have read that it is the female that incubates the eggs. By November 17 I was sure there were young in the nest as the parent present, who begged for food from its mate, ducked its head down into the nest with the offering.

26/11 The diet for the unseen occupants of the nest consisted of everything that could be labelled as animal protein – spiders, worms, lizard tails, grubs and caterpillars. The parent arriving with the food always alighted a few metres away on a power line which caused the nesting bird to become very excited, calling out and jiggling around.

By November 28 the sitting bird had left the nest, so now there were two parents foraging and delivering goodies to the young.

On November 30 I was finally able to see some greedy faces gaping above the rim of the nest with the arrival of the feeding parents. Judging by the size of some of the creatures stuffed into the mouths, there were some very large throats and crops in those tiny bodies!

Dusky Robin using swallows' nest

Chicks were offered spiders, worms, lizard tails, and caterpillars.

By December 3 the young were getting ready to go out into the world.

Shortly afterwards the family left the nest, and moved into a nearby melaleuca swamp, where I could hear their somewhat mournful whistling as the parents continued to feed their young. I occasionally caught a glimpse of the family, and within a couple of months the parents were back at the same nest and successfully raised a second brood.

By November 28 both parents were feeding chicks.

Before long the chicks were preparing to leave the nest.

Bassian Thrush

I was watching a bassian thrush recently. It had a worm in its beak, took a little leap and when it landed it did a little shimmy worthy of a pop star, which was obviously used to locate its next feed as it was followed by a rapid heads down to dig something out of the ground which it ate. It then picked up the worm, which it had dropped as it dived for the ground although too rapidly for me to see, took another leap onto a new spot and kept repeating the motions, all the time carting the worm along. When it was satisfied, it flew off with the still intact worm in its beak. Was the worm a special prize to be saved for someone else, or to be saved for dessert somewhere private?

The next time I observed the thrush, it had three worms and was again feeding himself on smaller creatures in between tossing the hapless worms onto the ground for picking up later. This time I am sure that the worms were for another bird, perhaps young in the nest. If, as I suspect, the thrush was saving a good number of larger prey for a visit to the nest, this would limit the number of trips the parent makes to the nest, thereby reducing the risk of a predator locating the nest.

Bassian Thrush with three worms.

Walks and other events

January 4 Vale of Belvoir Meet at 10.00 on Cradle Mountain Road about 100 m south of the junction with the "Link Road", now called Belvoir Road. There is a Telstra shed on the left hand side with places to pull off the road. The Tasmanian Land Conservancy may seek our help with some survey work and we will see some of the highlights of this magnificent sub-alpine valley. Any walking is off-track in open grassland/sedgeland.

February 1 February Plains Meet at O'Neils Picnic Ground, Gowrie Park (clearly marked on the Mt Roland side of Claude Rd, with toilets) **at 9.00 am** where we will pool transport. A 4 km return walk (with 200 m gentle climb) to the edge of February Plains and the recently restored Basil Steers trappers hut at 1050 m. This is west of the Mersey River and south of Borradaile Plains. The road is steep in places but OK for a 2WD with care.

March 1 Birralee Meet at 10.00 near the letterboxes at the end of Denmans Road at the bottom of the track to Sarah and Ron's place. (Denmans Road is off Priestleys Road that joins Birralee Rd (B72) to the Frankford Highway (B71)) We will walk up the track stopping along the way to look at some rich sites for slime moulds - and see some in the field. We can also look at myxos with hand lenses and microscopes. Don't forget your hand lens!

April 5 King Solomons Caves Mole Creek Meet at 10.00 at Mole Creek (outside the public toilets). We will travel to King Solomons Caves to check out the surrounding vegetation that includes wet forest, rainforest, bryophyte-covered rocks and logs and dry bush.

May 3 Dooleys Hills, Latrobe Genevieve Gates and David Ratkowsky will lead a fungi walk. Meet at 10.00 the carpark at Bells Parade near the Axemans Hall of Fame.

Deadline for the next newsletter is March 30. Please send unformatted word documents to the editor (email address below). Photographs should be reduced to approximately 600 KB and emailed separately.

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Swallow chicks in an old dusky robins' nest at Black Sugarloaf, Birralee

PRESIDENT: Phil Collier / 0438122110 / phil@rubicon.org.au
SECRETARY: Ron Nagorcka / 6396 1380 / ron@ronnagorcka.id.au
TREASURER & EDITOR: Sarah Lloyd / 6396 1380 / sarahlloyd@iprimus.com.au
Patron: Dr. Peter McQuillan
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