CALGAROO

Newsletter of the Parramatta & Hills District Group
Australian Plants Society NSW Ltd

Come to our Native Plant Sale

**There is still time for you to volunteer to help at a spot on the roster too! Contact Caroline Franks 0466 029 993 The more the merrier!

Visit the APS-Parramatta/Hills plant sale and grab yourself some wonderful natives for your garden, streetscape or balcony.

Find our table in the mall.

For sale will be:

- Native tube specimens,
- Native small potted specimens,
- Selected books on natives and local native plants
- With limited giveaways of past the journals: "Australian Plants" and "Native Plants for NSW"

Saturday, 28th July 2018

9 am to 5:00 pm

North Rocks Shopping Centre

328-336 North Rocks Rd NSW 2151

Parramatta & Hills District Group, APS
ABN 87 002 680 408

Contact us at
info@apsparrahills.org.au
or visit *apsparrahills.org.au*
or contact a Committee person

Australian Plants SOCIETY NSW

NATIVE BEES & OTHER POLLINATORS

Dr Michael Batley

Summary: Dr Marilyn Cross

On Saturday, 23rd June we were privileged to be addressed by Dr Michael Batley on the topic of Australian bees and other pollinators. Dr Batley is an honorary Research Associate of the Australian Museum with a special interest in Australian native bees. Let us begin with a definition of pollination from the Australian Museum:

"Pollination is the delivery of pollen to the female organs of a plant (stigma in flowers). Pollen is made by the male organs of a plant (stamens in flowers) and contains genetic information needed for plant reproduction. Pollen may be transferred to female organs on the same plant (self-pollination) or another plant of the same species (cross-pollination). As a result of pollination, the plants produce seeds. Pollen can be dispersed by wind, water and animal pollinators such as insects, bats and birds". https://australianmuseum.net.au/pollination

Many plants depend on animals, particularly insects, to transfer pollen as they forage. Plants attract pollinators in various ways, by offering pollen or nectar meals and by guiding them to the flower using scent and visual cues. The result is a strong relationships between plants and the animals that pollinate them (Australian Museum, 2018). However, a key scientific question that is not easily answered is 'What pollinates what?'. That question has engaged Michael over the last few decades. It is estimated that there is some degree of specialisation in ~8% of bees. One intriguing example is that of 'inside out flowers' such as figs where the male wasps live inside the figs and the female sometimes rips off her wings before visiting the male and incidentally pollinating the fig flower.

Pollinators include birds, marsupials, bats, butterflies, moths, wasps, beetles, thrips and bees. The small antechinus pollinates toothbrush grevilleas while various honeyeaters, such as the eastern spinebill, visit *Lambertia formosa,* many species of *Eremophila* and some epacrid flora, such as *Epacris longiflora*.

Australia has more than 1500 species of native bees that adopt a variety of methods to harvest nectar from flowers and the flowers themselves have some degree of adaptation to attract pollinators. However, extreme mutualism is rare. In general, if one partner is a specialist, the other is a generalist.

"Convergent floral traits hypothesized as attracting particular pollinators have been described as pollination syndromes. However, the traditional syndromes described by Faegri and van der Pijl (1979) have been shown to be unreliable predictors of major pollinators in some plant communities (Hingston and McQuillan, 2000; Ollerton et al., 2009). The accuracy of these syndromes also differs across plant families (Johnson, 2013). Floral diversity suggests that the Australian epacrid flora may be adapted to pollinator type. Currently there are empirical data on the pollination systems for 87 species (approx. 15% of Australian epacrids). This provides an opportunity to test for pollination syndromes and their important morphological traits in an iconic element of the Australian flora.

Floral attributes are correlated with bird, fly and bee pollination. Using floral attributes identified as correlating with pollinator type, bird pollination is classified with 86 % accuracy, red flowers being the most important predictor. Fly and bee pollination are classified with 78% and 69 % accuracy but have a lack of individually important floral predictors. Excluding mixed pollination systems improved the accuracy of the prediction of both bee and fly pollination systems.

Although most epacrids have generalized pollination systems, a correlation between bird pollination and red, long-tubed epacrids is found. Statistical classification highlights the relative importance of each floral attribute in relation to pollinator type and proves useful in classifying epacrids to bird, fly and bee pollination systems" (Johnson, 2013).

Some species of bee favour pea flowers as they are strong enough to open the keels of the flower to find the nectar and in the process being dabbed with pollen. The blue banded bee is a buzz pollinator that vibrates its head against flowers with poricidal anthers at the rate of 350 times/second to shake free the pollen (Calyx Centre, Royal Botanic Gardens, 2018, https://www.rbgsyd.nsw.gov.au/the-calyx . Geebungs - *Persoonia* species are visited by many different kinds of bee, but a small number of bee species have evolved modified body parts that have helped them become specialist foragers from *Persoonia*.

The frequency of specialisation by flowers is particularly high among orchids. This is possibly because they have evolved symbioses with fungi, which has the consequence that they need to produce large numbers of seeds in order that some land where a suitable fungus is present. An orchid's pollen is held in a packet so that all the pollen is removed by a single visitor. This makes narrow specialisation much less hazardous. The mechanisms that have been evolved by orchids are varied and include the use of sexual pheromones to attract male bees and wasps and fool them into attempting to mate with orchid flowers, thereby acting as pollinators.

Our summary has attempted to give some flavour of Michael's fascinating talk but to find out more, one could begin by consulting the publication: Native Bees of the Sydney Region. A Field Guide by Dollin, A., M. Batley, M. Robinson & B. Faulkner (2000).

PLANTS REALLY DO FEED THEIR FRIENDS

From Calyei - Northern Beaches Newsletter APS - Science News March 22, 2018 Lawrence Berkeley

Rhizosphere soil for microbial isolations was collected from the Little Buck watershed at the University of California Hopland Research and Extension Center in an area in which Avena barbata are the dominant vegetation. Credit: Heejung Cho

National Laboratory

Researchers at the Department of Energy's Lawrence Berkeley National Laboratory (Berkeley Lab) and UC Berkeley have discovered that as plants develop they craft their root microbiome, favoring microbes that consume very specific metabolites. Their study could help scientists identify ways to enhance the soil microbiome for improved carbon storage and plant productivity.

"For more than a century, it's been known that plants influence the makeup of their soil microbiome, in part through the release of metabolites into the soil surrounding their roots," said Berkeley Lab postdoctoral researcher Kateryna Zhalnina, the study's lead author. "Until now, however, it was not understood whether the contents of this cocktail released by plants was matched by the feeding preferences of soil microbes in a way that would allow plants to guide the development of their external microbiome."

The study, "Dynamic root exudate chemistry and microbial substrate preferences drive patterns in rhizosphere microbial community assembly," has just been published in the journal Nature Microbiology. The corresponding authors were Berkeley Lab scientists Trent Northen and Eoin Brodie.

Microbes within soil improve the ability of plants to absorb nutrients and resist drought, disease, and pests. They mediate soil carbon conversion, affecting the amount of carbon stored in soil or released into the atmosphere as carbon dioxide. The relevance of these functions to agriculture and climate are being observed like never before.

Just one gram of soil contains tens of thousands of microbial species. Scientists have long known that plants impact the composition of the soil microbiome in the area surrounding their roots by sending out chemicals (metabolites). Prior work by Mary Firestone, Berkeley Lab faculty scientist and a professor of microbiology at UC Berkeley, had shown that plants were consistently selecting or suppressing the same types of microbes over time in the root zone, suggesting some form of synchronization between plant and microbiome development.

Yet, little research had gone into the relationship between specific metabolites that plants release and the microbes consuming them. The new study brought together experts in soil science, microbial and plant genomics, and metabolomics to explore these potential metabolic connections. Their study took a close look at the rhizosphere of an annual grass (Avena barbata) common in California and other Mediterranean ecosystems.

The Berkeley Lab team felt the time was ripe for doing so. As pressure mounts for farmers to grow enough healthy crops to meet a burgeoning population's needs, and for new land management strategies that improve soil carbon storage to reduce atmospheric CO2 and produce healthy soils, the soil microbiome is the subject of more in-depth scientific research than ever before.

The researchers set out to determine the relationship between microbes that consistently bloomed near the grass roots and the metabolites released by the plant. Their first step was to collect soil from the University of California's Hopland Research and Extension Center in northern California. Brodie, deputy director of Berkeley Lab's Climate and Ecosystem Sciences Division, and his group used what they knew about the lifestyles of these soil bacteria to develop specialized microbial growth media to cultivate hundreds of different bacterial species. They then selected a subset that either flourished or declined as roots grew through the soil.

This collection of microbes was then sent to the Joint Genome Institute (JGI), a DOE Office of Science User Facility, where their genomes were sequenced to provide clues as to why their responses to roots differed. This analysis suggested that the key to success for microbes that thrived in the rhizosphere was their diet.

Northen, senior scientist in Berkeley Lab's Environmental Genomics and System Biology Division, is fascinated by the chemistry of microbiomes, and his group has developed advanced mass spectrometry-based exometabolomic approaches to elucidate metabolic interactions between organisms. Zhalnina and Northen combined their expertise to identify what the more successful microbes surrounding the roots of the Avena grasses preferred to eat.

Using a hydroponic setup at the JGI, they immersed plants at different developmental stages in water to stimulate them to exude their metabolites, then measured the metabolites being released by the plants using mass spectrometry. Subsequently, the cultivated soil microbes were fed a cocktail of root metabolites, and the researchers used mass spectrometry to determine which microbes preferred which metabolites.

They found that the microbes that flourished in the area around plant roots preferred a diet more rich in organic acids than the less successful microbes in the community. "Early in its growth cycle, the plant is putting out a lot of sugars, 'candy', which we find many of the microbes like," Northen said. "As the plant matures, it releases a more diverse mixture of metabolites, including phenolic acids. What we discovered is that the microbes that become more abundant in the rhizosphere are those that can use these aromatic metabolites."

Brodie describes these phenolic acids as very specific compounds released by plants throughout their development. Phenolic acids are often associated with plant defenses or plant-microbe communication. This indicates to Brodie that as they establish the microbial community within the rhizosphere, plants could be exuding metabolites like phenolic acids to help them control the types of microbes thriving around their roots.

"We've thought for a long time that plants are establishing the rhizosphere best suited to their growth and development," said Brodie. "Because there are so many different types of microbes in soil, if the plants release just any chemical it could be detrimental to their health. "By controlling the types of microbes that thrive around their roots, plants could be trying to protect themselves from less friendly pathogens while promoting other microbes that stimulate nutrient supply."

Zhalnina, Firestone, Northen, and Brodie believe their findings have great potential to influence additional scientific and applied research. Zhalnina points out that a lot of research and development is currently underway by government and industry to harness the power of microbes that improve plant yield and quality of soil to help meet society's growing demands for a sustainable food supply.

She said, "It's exciting that we can potentially use the plant's own chemistry to help nourish beneficial microbes within soil. Population growth, especially, has created a demand for identifying more reliable ways to manipulate the soil microbiome for beneficial outcome."

Let's adopt a threatened plant species.

There is a suggestion that our group might like to "adopt" a threatened native species in our area and engage in activities to promote its awareness, propagate it and perhaps help to improve its population in the wild as well.

Some suggestions for plants to adopt include; Epacris purpurascens (Ericaceae); Leucopogon fletcheri (Ericaceae) and Acacia gordonii (Fabaceae).

We hope to discuss this at the next meeting on August 25th. So put on your thinking caps. Suggestions welcome!

Meanwhile, here are some details about the candidates suggested so far.

Epacris purpurascens:

This plant is listed as Vulnerable in NSW. It is an erect shrub 50-180cm high. Flowers are showy, 7 - 10 mm diam., covering much of the branchlets. Flowers are white or sometimes pinkish.

Epacris purpurascens
Photo: NSW Office of Environment & Heritage

It is found in a range of habitat types, most of which have a strong shale soil influence. Plants live for between 5 and 20 years, requiring 2-4 years before seed is produced in the wild.

While it is killed by fire it usually re-establishes from soil-stored seed.

As with many threatened species, the habitats of Epacris purpurascens which remain, particularly on ridge-tops, are under increasing threat of clearance or habitat modification resulting from urban or rural development. Existing populations are directly threatened by urban run-off leading to flooding, erosion, nitrification of soil substrate, altered pH, weed invasion, and introduction of plant pathogens. Other threats include altered fire regimes, uncontrolled vehicular access, soil compaction, slashing (eg. powerline easements) fill and rubbish dumping, and trampling through inappropriate pedestrian access.

Leucopogon fletcheri :

This is an erect densely branched shrub which is seldom more that 1 m high, with narrow pungent-pointed leaves 3.7 - 8 mm long. The white flowers are pendant-like, tubular, 4 - 5 mm long, hairy inside tube and are borne singly but

Calendar

July

Sat 28 North Rocks Plant Sale 8:30am - 5:30pm

Aug

Mon 11 Deadline for Calgaroo news and articles

Wed 13 Propagation at Bidjiwong Community Nursery 10am to 1 pm

Sat 25 2 - 4pm Meeting with Guest speaker Brian Roach - "Native Plants for a Cottage Garden"

Sep

Wed 12 Propagation at Bidjiwong Community Nursery 10am to 1 pm

Sat 15 2 - 4pm Meeting with Guest speaker Andrew Berneutz on the topic "Breeding Australian Native Plants"

abundantly along ends of branches.

It's habitat is restricted to north-western Sydney between St Albans in the north and Annangrove in the south, within the local government areas of Hawkesbury, Baulkham Hills and Blue Mountains.

Leucopogon fletcheri occurs in dry eucalypt woodland or in shrubland on clayey lateritic soils, generally on flat to gently sloping terrain along ridges and spurs. It flowers August to September, with fruit produced in October.

Evidence suggests the species responds slowly to fire. The species is an obligate seeder and slow growing with a maturation period likely to exceed 5 years.

The main threats to this species are from habitat loss and fragmentation due to clearing for rural and rural-residential development. Fire is a problem for this species as there is high pressure for hazard reduction burns in its area and a minimum fire interval of 10 years is required for species survival as it is slow to mature and an obligate seeder.

Leucopogon fletcheri - Photo: Alan Fairley

Accacia gordoni:

An erect or spreading shrub, 0.5 - 1.5 m high, with smooth grey bark. Branchlets and leaves (phyllodes) are usually hairy. Phyllodes are alternate or sometimes whorled or clustered, straight or almost sickle-shaped, 5 - 15 mm long, about 1 mm wide, with a pointed tip. Flower heads are golden yellow arising singly in the angle between phyllodes and the stem on a hairy peduncle (stalk) that is 8 - 12 mm long. The seed pod is 25 - 55 mm long, 9 - 14 mm wide, and glaucous (dull blue-green in colour with a whitish bloom).

Restricted to the north-west of Sydney, it has a disjunct distribution occurring in the lower Blue Mountains in the west, and in the Maroota/ Glenorie area in the east. This species is known from only a few locations and current information suggests the total number of individuals may be less than 2000, with only one population supporting greater than 400 individuals. A relatively large proportion of individuals (approximately 850) occur on conservation reserve within Blue Mountains National Park. This species is found within the Hawkesbury, Blue Mountains and Baulkham Hills local government areas.

Acacia gordonii
Photo: Royal Botanic Gardens Trust

It grows in dry sclerophyll forest and heathlands amongst or within rock platforms on sandstone outcrops.

While habitat loss, for example due to clearing, urban development and road maintenance and habitat degradation due to recreational users in its habitat are the primary threats, Indian Lovegrass in and around areas where the species occurs is also a threat.

Victorian APS Event

Showcasing Goodeniaceae at the

12th FJC Rogers Seminar to be held in Horsham, Victoria 20-21st October.

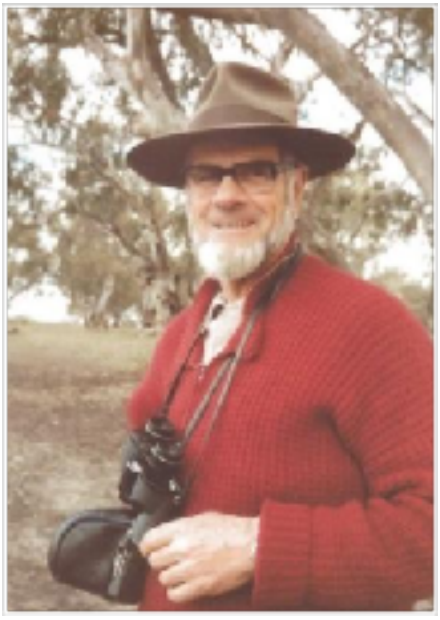
For details visit:
apsvic.org.au/fjc-rogers-seminar

Keynote speaker Dr Kelly Shepherd, Senior Research Scientist based in Perth, whose interests include the 'salt-loving' samphires.

Guest speaker **Brendan Lepschi** from Australian National Herbarium talking about his interests in Melaleuca, Santalaceae and Goodeniaceae. Guest speaker **Neville Walsh**, Senior Conservation Botanist at Royal Botanic Gardens Victoria.

Sunday includes garden tours to Wartook Gardens

Lechenaultia biloba 'Blue Lechenaultia'
Photo: Neil Marriott



F J C "Fred" Rogers

GRAPTOPHYLLUM ILICIFOLIUM

from Jennifer Farrer

The recent edition of Australian Plants, featured articles about Rainforest. One of the articles by Lawrie Smith, "Fifty shades of green- the magic of rainforest" included photos of his selection of the most rewarding rainforest plants to grow. Amongst them was *Graptophyllum ilicifolium.*

I have had this plant growing in my garden for more than 20 years and it is indeed rewarding. It is native to dry rainforest from Mackay to Rockhampton. It is often found in rocky areas or along dry creek banks. It prefers excellent drainage and part shade. Mine is growing where it gets the afternoon sun.

The foliage is stiff and prickly like holly, in fact *ilicifoilum* means leaves like holly. The flowers are large and tubular and an attractive deep fuchsia pink. The flowers appear between August and November and are attractive to nectar feeding birds.

We have grown plants at the Community Nursery from cuttings and there are some available for anyone who would like to try one.

Another plant which has been grown successfully at the nursery recently is the West Australian Woollybush, *Adenanthos sericeus.* This was featured in an article by John Knight in the recent edition of *Native Plants.* This plant grown in a pot has become popular as a Christmas Tree.

Library Books

The following list of books are Reference books from the collection held by our Group. As the library is being disposed of, these books are available to interested members. The books are currently held by Sue Gibbons, our Library Officer so please contact her if you are interested in any of them.

There are also 19 volumes of the Flora of Australia and a set of Encyclopedia of Australian Plants Suitable for Cultivation (in 4 Volumes) by W Rodger Elliot & David L Jones.

It may be best to donate the 19 Volumes of Flora of Australia to an appropriate organisation. Suggestions welcome.

Australian Brachyscomes - Australian Daisy Study Group

Acacias of Australia - Marion Simmons

Acacias of NSW - Inez Armitage

Australian Wattles - D. Baglin & B. Mullins

Growing Acacias - M. Simmons

The Banksia Book - A. S. George

A Field Guide to Banksias - I. Holliday, G Watton

Banksias, Waratahs & Grevilleas & other plants in the Australian Proteaceae Family - J. Wrigley & M. Fagg

Beach Plants of South Eastern Australia - R. Cardin & P. Clarke

Cradle of Incense - The Story of Australian Prostanthera - G Althofer

An Introduction to the Genus Cycas in Australia - S. Butt

Eucalypts- Volume Two - Stan Kelly

Eremophilas - The Study Group Newsletters 1972 - 1985 - SGAP - SA

Australian Grasses - N. T. Burbridge

Guide to the Grasses of Sydney - Van Klaphake

Australian Ferns & Fern Allies - D. Jones & S. C. Clemsha

Best Practice Guidelines Hygrocybeae Community of Lane Cove Bushland Park - Published by Department of Environment & Climate Change

A Field Guide to the Mangroves of NSW - J. B. Williams & G. J. Harden

Mountain Devil to Mangrove - A Guide to Natural Vegetation in the Hawkesbury-Nepean Catchment -D Benson,J Howell,L McDougal

Melaleucas - A Field & Garden Guide - I. Holliday

Australian Native Orchids - B Mullins, P Lindsay, W Ford

Australian Orchid Review - Vol 71 No.5 2006

A Checklist of Australian Native Orchid Hybrids - Council of Aust Native Orchid Society

Cultivating Australian Native Orchids - Australian Native Orchid Society (Vic)

Field Guide to Australian Orchids - M Hodgson, R Paine

Palms in Australia - D Jones

An Introduction to the Zamiaceae in Australia - L Butt

Australian Plant Genera - An Etymological Dictionary of Australian Plant Genera - J Baines

The Wordsworth Dictionary of Botany - G Usher

The Language of Botany - C Debenham

Australian Flora in the Endangered Species Convention - J Leigh, R Boden

Extinct and Endangered Plants of Australia - J Leigh, R Boden, J Briggs

Field Guide to Native Plants of Sydney - G Robinson

Forest Trees of Australia - D Boland, M Brookes, G Chippendale, N Hall, B Hyland, R Johnston, D Kleinig, J Turner

Ocean Shores to Desert Dunes - The Native Vegetation of NSW & ACT - D Keith

Plant Life of Australia - V Serventy

Wildflowers of Australia - Thistle Harris

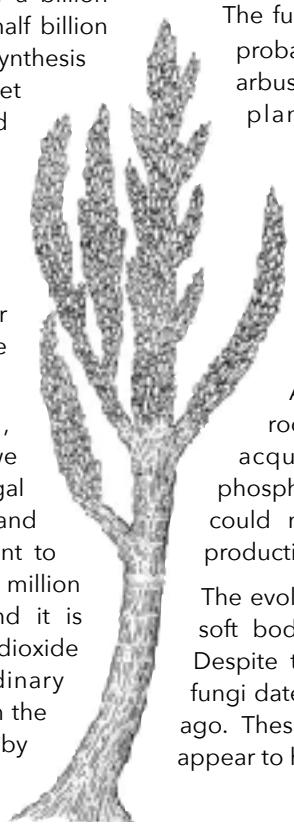
Fifty Years of Promoting Australian Plants - T Cavanagh J Walter, J Sked

A Little History - Plants and Fungi

The story of the evolution of life on earth is an ever changing story. It is constantly being updated by new research. So this article is a little about current knowledge.

The first simple life (prokaryotes) is thought to have evolved around 4 billion years ago, about half a billion years after the formation of the earth. Another half billion years later, single-celled life developed photosynthesis and started producing oxygen. Then we get Eukaryotes, slightly more complex single celled life and then by 1.5 billion years ago life becomes multicellular. During this long slow early evolution, oxygen in the atmosphere was rising - from oxygen produced by photosynthesising algae - and falling, due to various geological weathering processes. Over these billions of years, life was confined to the oceans.

Then, about 1.2 billion years ago, photosynthesising life appears on land. But we can't call these plants. They were more like algal scum living in shallow wet areas on the land, and their relatively small numbers were not sufficient to affect atmospheric oxygen concentrations. 850 million years ago, the first simple plants appear. And it is thought that their activity, absorbing carbon dioxide from the atmosphere, caused an extraordinary geologic event labeled 'snowball earth", in which the earth is believed to have been entirely covered by ice. This event during the "Cryogenian" period lasted for over 200 million years.



An 1888 reconstruction of a conifer-like *Prototaxites*

For life to move out of water onto dry land, cells needed to evolve ways to avoid drying out as well as to perform reproductive functions in a dry environment. Some of this evolution appears to have happened, surprisingly, during the Cryogenian period. However, plants had another challenge to overcome. Once on land, the early plants had no roots to extract nutrients from the rocks, sands, silts and clays. Nor did they have a vascular systems for transport of water and nutrients either. Recent discoveries indicate some of the earliest plants had a mycorrhizal relationship with fungi which formed arbuscules, literally "tree-like fungal roots". The fungi fed on the plant's sugars, in exchange for nutrients generated or extracted from the soil (especially phosphate), to which the plant would otherwise have had no access. Like other rootless land plants of the Silurian and early Devonian an early pioneer plant, *Aglaophyton,* may have relied on arbuscular mycorrhizal fungi for acquisition of water and nutrients from the soil.

The fungi were of the phylum Glomeromycota, a group that probably first appeared 1 billion years ago and still forms arbuscular mycorrhizal associations today with all major land plant groups from bryophytes to pteridophytes, gymnosperms and angiosperms and with more than 80% of vascular plants living on our planet today.

Evidence from DNA sequence analysis indicates that the arbuscular mycorrhizal mutualism arose in the common ancestor of these land plant groups during their transition to land and it may even have been the critical step that enabled them to colonise the land. Appearing as they did before these plants had evolved roots, mycorrhizal fungi would have assisted plants in the acquisition of water and mineral nutrients such as phosphorus, in exchange for organic compounds which they could not synthesize themselves. Such fungi increase the productivity even of simple plants such as liverworts.

The evolution of fungi is not so easy to determine because the soft bodies of fungi do not readily enter the fossil record. Despite this, the earliest fossils possessing features typical of fungi date to the Paleoproterozoic era, some 2,400 million years ago. These early fungi, up to around 250 million years ago, appear to have been aquatic.

Fungi probably colonised the land during the Cambrian (542–488.3 Ma), long before land plants. And for this fungi used strategies such as parasitism and mutualistic relationships such as mycorrhiza and lichenization. *Prototaxites,* which was probably a fungus or lichen, would have been the tallest organism of the late Silurian (approx. 430 to 360 Ma). *Prototaxites* formed large trunk-like structures up to 1 metre (3 ft) wide, reaching 8 metres (26 ft) in height, made up of interwoven tubes around 50 micrometres (0.0020 in) in diameter, making it by far the largest land-dwelling organism of its time. The first specimen of Protaxes was collected in 1843 and was variously considered to be a conifer, a yew, stringy algae until debate was resolved and it was found to be a giant fungi in 2007.

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