THE QUEENSLAND MYCOLOGIST

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The Queensland Mycological Society

ABN No 18 351 995 423

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Society Objectives

The objectives of the Queensland Mycological Society are to:

1. Provide a forum and a network for amateur and professional mycologists to share their common interest in macro-fungi

2. Stimulate and support the study and research of Queensland macro-fungi through the collection, storage, analysis and dissemination of information about fungi through workshops and fungal forays

3. Promote, at both the state and federal levels, the identification of Queensland's macrofungal biodiversity through documentation and publication of its macro-fungi

4. Promote an understanding and appreciation of the roles macro-fungal biodiversity plays in the health of Queensland ecosystems

5. Promote the conservation of indigenous macro-fungi and their relevant ecosystems.

Membership

Membership of QMS is $25 per annum, due at the beginning of each calendar year, and is open to anyone with an interest in Queensland fungi. Membership is **not** restricted to people living in Queensland. Membership forms are available on the website, http://qldfungi.org.au/.

Please notify the membership secretary (memsec@qldfungi.org.au) of changes to contact details, especially your email address.

The Queensland Mycologist

The Queensland Mycologist is issued quarterly, **but issues will be combined if there is insufficient material for four.** Members are invited to submit short articles or photos to the editor for publication. It is important to note that it is a newsletter and not a peer-reviewed journal. However we do aspire to high standards of accuracy and there is an extensive review process.

Material can be in any word processor format, **but not PDF.** The deadline for contributions for the next issue is **15 November 2023**, but if you have something ready, please send it **NOW**! Late submissions may be held over to the next edition, depending on space, the amount of editing required, and how much time the editor has, or the newsletter may come out late. Email contributions to the secretary.

Photos should be **submitted separately at full-size** to allow flexibility in resizing and cropping to fit the space available while minimising loss of quality. Authors who have specific preferences regarding placement of photos should indicate in the text where they want them, bearing in mind that space and formatting limitations may mean that it is not always possible to comply. Material from published sources (including internet sites such as Wikipedia) may be included **if that complies with copyright laws and the author and source are properly acknowledged.** However extensive verbatim copying is not acceptable.

Cover Illustration

Vanessa and Chris Ryan had some wattles cut down and Vanessa kept some pieces to see what fungi would grow on them. These tiny fruiting bodies slowly grew on one of the logs. When they were finally big enough, Vanessa photographed them one afternoon, planning to collect them the next morning. Overnight, a slug ate them! Photo © Vanessa Ryan.

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QMS activities

Meetings

Meetings are held on the second TUESDAY of the month at the Queensland Herbarium, Mt Coot-tha, from 6:30 – 8:30 pm.

Meetings are held monthly from February (no January meeting), unless otherwise scheduled. **Check the website for details and any changes.** There are typically 3-4 guest speakers invited during the year, with the other meetings informal. Suggestions from members for topics or names of potential speakers will be welcome at any time. Please contact a member of the Committee.

We like to publish notes from presentations in the *Queensland Mycologist*. However, the notes never do justice to the topic as they do not reflect the enthusiasm of the speaker or cover the discussion that follows, and not all talks are written up for the newsletter. If you do present at a meeting, a summary of that presentation that can be turned into a newsletter article will be greatly appreciated. But it is better to attend the meetings, get the information first hand, and participate in these invaluable information sharing opportunities.

Forays

QMS holds regular forays during the first half of the year. The dates are nominally the 4th Saturday of the month, but actual dates may vary and additional forays may also be held. Field trip details may change as a result of drought or other unforeseen circumstances. Check the website for changes.

Members are invited to suggest venues for additional forays. If you have any suggestions, (and especially if you are willing to lead a foray), please contact Wayne Boatwright or another member of the Committee.

Workshops

What do you, our members, want to learn more about that could be presented in a workshop? QMS is always on the lookout for workshop ideas. Members are encouraged to suggest topics, whether new or reruns of past workshops. Send your ideas to Wayne Boatwright (info@qldfungi.org.au).

Details of workshops will be included in newsletters and on the QMS website as they become available.

The Australasian Mycological Society

A reminder that the Australasian Mycological Society is well worth joining.

Their home page is at: https://www.australasianmycologicalsociety.com/

They also have virtual seminars. For more information visit the website.

QMS Program 2023

MONTH	MEETINGS	FORAYS/WORKSHOPS
Look out for emails from Wayne Boatwright for updates on meetings and forays.		
October	Fran Guard: Cooloola foray and Amanita species	
November	Vanessa Ryan: Lichens	
December		

Editor's Comments

It has been a year since the last newsletter, for which I apologise. However, a newsletter requires content and it took a very long time for me to receive enough material to be able to put this edition together. On top of that, extra time was also required for editing. The newsletter really does need more people to step up and provide material.

There have been several forays this year but I have received no foray reports. Unfortunately I was unable to make it to any, but regardless, I am not keen on being both editor and writing a significant proportion of articles, even if I can find the time. As I finally wind down into (almost) complete retirement I hope to be able to devote more time to QMS.

I have (optimistically perhaps) referred to this issue as 1-2 rather than 1-3 and I do hope to receive enough material for another issue in December. If anybody has notes and photos from any of the forays over the last year, please prepare something for the newsletter. I and others can help build up the text if we have the basic details, though a personal touch from someone who was there is best.

If you have taken photos of fungi where you live, or on your travels we would love to have them, though we do need some idea of what they are, something that is not always easy. Other QMS members and especially our specialists may be able to help there. Even better if there is a story to go with the photo (as there is this month for the cover photo. Thank you Vanessa).

I am always looking for photos for the front cover. While it is good if they relate to an article, they can also be stand-alone photos, even unknowns if suitably eye-catching.

Once again I thank the authors, and greatly appreciate the editing work put in by a seriously overworked Nigel Fechner, Warwick Nash and Vanessa Ryan. Thanks also to Roger Shivas for his technical input to the *Isaria sinclairii* article. Because it is so late I have bypassed the usual panel of proof readers, so apologies if there are more typos than usual.

There are four articles in this newsletter: Judith Hewitt wrote up a foray from 2022, as well as writing a note on *Isaria* (=*Cordyceps*) *sinclairii* that she found at her place. That fungus was of great interest to me and I added a note on it, covering isolation into culture and the naming of the genus, which is not completely clear-cut at the moment. Fran has written a note on another undescribed fungus, a species of *Cryptomarasmius*, with an interesting story about its taxonomy. I found a recent paper on degradation of plastics by fungi and added a very short note with links to two publicly available references.

Finally, Vanessa Ryan has put in a colossal amount of work on the first of what will be a series on the history of Western taxonomy, starting with the ancient world.

Two Recently Described Australian Macrofungi

These descriptions were published in *Fungal Planet Description Sheets*, part of the Journal *Persoonia*. The sheets come out in blocks twice a year, and these species are from December 2022 and June 2023. They can be downloaded from https://www.ingentaconnect.com/content/nhn/pimj;jsessionid=wve9k2kv8etr.x-ic-live-03

First, congratulations Fran on another description:
Marasmius brunneolorobustus F.E. Guard, T. Lebel & Dearnaley
Fungal Planet 1453 – 20 December 2022

Another *Agaricus*, from Teresa Lebel's group in Adelaide:
Agaricus pateritonsus T. Lebel, Boxshall & Broadbridge
Fungal Planet 1437 – 20 December 2022

Mount Tambourine Residential Weekend 25th March 2022

The Knoll section of Mt Tambourine National Park.

Judith Hewett

Park entrance. Photo © Judith Hewett.

Charmaine Thomas and I arrived early on Friday, so with time to spare we chose a walk at the Knoll Section of Mt Tambourine National Park. We walked the Sandy Creek Circuit, an easy grade walk through a pristine section of flooded gums and piccabeen palm groves.

***Cymatoderma elegans.* © Charmaine Thomas.**

Hollow Tree. © Charmaine Thomas.

Fungi were scarce along the path although we did see large *Cymatoderma elegans* on an old log.

Once past the Hollow Tree and onto the circuit track along Sandy Creek the fungi spotting improved. There were numerous small brown agarics interspersed with a small collection of *Marasmius* sp. among the forest floor mulch. The moist fallen logs had numerous leathers and polypores attached.

Then we saw what looked like a cluster of boletes emerging from the cavity in the root system of a large fallen tree. There were five brown caps which appeared deeply attached to the wood. We selected one for a closer look with the camera and its underside appeared to be something other than pored or gilled. Back at the residential site Fran Guard dissected the specimen and revealed that it was in fact gilled but that it had an intact and very thick veil covering the lamellae.

I returned to the site the following day and collected all five specimens. In retrospect I believe all five were juveniles because of their small size. They were difficult to remove from their wood substrate. The stipes were all quite long and robust, though not entirely cylindrical. I stored the specimens overnight in a refrigerator. On Sunday the thick veil was separating from the outer edge of the cap on all specimens. This revealed a very heavy deposit of spores on the inner surface of the veil. The outer

surface of the veil was becoming scurfy and was no longer smooth in appearance.

After I returned home on Sunday I took the specimens to Patrick Leonard, who looked at them, listened to my brief description and then said “something like this”, as I turned to view his laptop screen. It was *Agrocybe parasitica*.

***Cyclocybe parasitica*. © Judith Hewett.**

***Cyclocybe parasitica* in situ. © Charmaine Thomas.**

This species occurs in New Zealand as well. It was originally described by Greta Stevenson (1982). We examined the spores microscopically and determined that they were dark brown, ellipsoidal and smooth walled, as described by Greta.

Originally this fungus was called *Agrocybe parasitica*. In more recent publications it is referred to as *Cyclocybe parasitica.*

Underside of cap, and thick veil with brown spore print © Judith Hewett..

Scurfy veil as it dries. © Judith Hewett.

A collection of *Cyclocybe parasitica* showing a range of sizes. © Judith Hewett.

References

Fuhrer, B. (2009). *A field guide to Australian fungi.* Bloomings Books: Melbourne pp. 20-21 [as *Agrocybe*]

Gates, G. and Ratkowsky, D. (2014). *A Field Guide to Tasmanian Fungi.* Tasmanian Field Naturalists Club; Hobart, Tasmania. p. 28 [as *Agrocybe*].

Hubregtse, J. (2019). *Fungi in Australia, Revision 2.2, Part 3, Basidiomycota*. e-published by the Field Naturalists Club Victoria Inc, Blackburn, Victoria, Australia, pp. 439-441 [as *Agrocybe*]. https://www.fncv.org.au/fungi-in-australia/

Kerr, S. (2019). *A Field Guide to New Zealand Fungi.* Self published. p. 75 [as *Cyclocybe*].

Stevenson, G. (1982). A Parasitic Member of the Bolbitiaceae*, Agrocybe parasitica* sp. nov. New Zealand Journal of Forestry 27: 130-133.

There are currently 84 observations listed on iNaturalist, with 6 listed from sites in Queensland in 2022. They are all called *Cyclocybe parasitica.*

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An Interesting Find in My Garden

Judith Hewett

Well, it was for me anyway. I noticed small fungal like structures emerging through the moss growing around a *Glochidion sumatranum*, or large-leaved cheese tree. When I touched the structures, a large spore plume drifted into the atmosphere. I dug one of the items from the soil and was then surprised to find that the fungus was attached to a white mass, which on closer inspection appeared to be encasing a grub of some kind.

***Isaria sinclarii.* © Judith Hewett.**

Over the subsequent weeks numerous similar fungal spore bodies emerged from the earth, producing creamy-white tufts that released clouds of powdery spores when disturbed. The stipes were thin and fragile, and the many small tree roots in my yard made excavating the fungi difficult. The fungus was identified by Pat Leonard as *Isaria sinclairii* (Cordycipitaceae), a species of entomopathogenic fungus which mostly infects the underground nymphs of cicadas. The Cordycipitaceae is a large family that currently includes about 20 genera.

The infected nymphs had died just beneath the soil surface, allowing the fungi to extend their spore producing structures above the ground to release their conidia (spores).

I do not know the identity of the cicada, but the exoskeltons left behind on the tree when uninfected cicada emerged were typical of some of the smaller species.

***Isaria sinclarii* showing the size of the specimen. © Judith Hewett.**
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Additional Notes

David Holdom

This was an interesting find for me too, and thanks to Judith I was able to collect specimens and isolate the fungus into culture. It grows readily and sporulates profusely on Sabouraud's dextrose agar supplemented with 1% yeast extract, a medium commonly used for fungal pathogens of insects.

The cultures have been accessioned into the Queensland Plant Pathology Herbarium (BRIP) as BRIP 75551 and BRIP 75552, *Isaria* aff. *sinclairii*, on parasitised cicada (Arthropoda, Insecta, Hemiptera, Auchenorrhyncha, Cicadoidea, Cicadidae), Nambour, Qld, coll. D.G. Holdom & Judith Hewitt, 26/12/2022.

While the consensus seems to be that *Cordyceps* is the correct name for *Isaria*, Species Fungorum lists *Isaria sinclairii* as an accepted current name. Fan et al. (2019) discussed *Isaria cicadae* and noted that the naming of the fungus was confused, with multiple names in use, including *I. sinclairii*.

A great deal more collections are needed, and further taxonomic work is required to sort out the *Isaria*/*Cordyceps* complex of species.

A culture (top), conidiophores and conidia of *I. sinclairii*. Photos © D. Holdom.

Reference

Fan, W-W, Zhang, S., and Zhang, Y-J. (2019) The complete mitochondrial genome of the Chan-hua fungus *Isaria cicadae*: a tale of intron evolution in Cordycipitaceae. *Environmental Microbiology* **21(2)**, 864–879. DOI: 10.1111/1462-2920.14522

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Cryptomarasmius - the Ultimate LBMs

Frances Guard

The genus *Cryptomarasmius* is a small group of fungi that have recently (2014) been split off from *Marasmius* (in the strict sense). They are usually tiny brown mushrooms that most people would step on and not even notice. One could be forgiven for calling them BLBMs – "boring little brown mushrooms". However, hidden inside their dull brown caps and on their dark stems are beautiful microscopic features. There is also an interesting story as to how they came to be transferred from the family Marasmiaceae to a completely different family, Physalacriaceae, a very diverse group that includes parasitic species such as *Armillaria mellea*, edible species such as *Flammulina filiformis* (enoki) and rotters such as the tiny deflated balloons of *Physalacria inflata*. *Cryptomarasmius* are also rotters – saprotrophs decomposing leaf and woody litter.

***Cryptomarasmius* sp. in situ and close-up of gills. © Frances Guard.**

The story of this genus is all about the DNA. The name suggests the species' hidden (cryptic) nature and their original placement in the genus *Marasmius*, section *Hygrometrici*. As members of that section, they shared several distinctive macroscopic and microscopic features with core members of Marasmius, including tiny parasol-like caps, moderately sparse white gills, wiry insititious stems and rotalis-type broom cells on the cap
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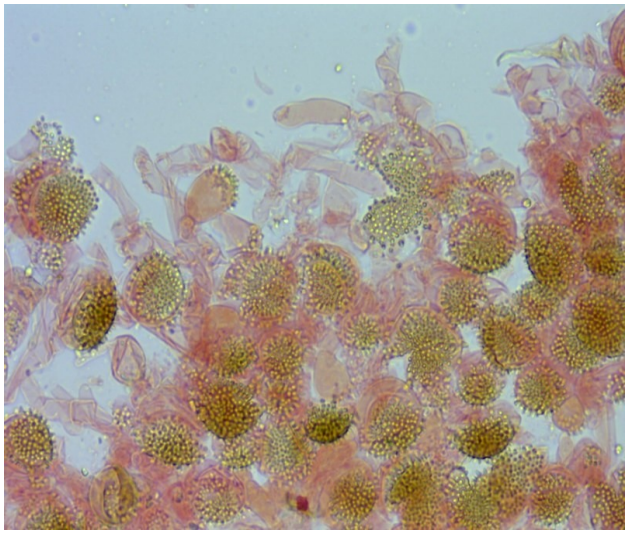
surface layer (pileipellis). Given they are now in different families, this raises the question as to whether the very distinctive feature of broom cells is an ancestral character, or if it has evolved on several occasions. The stipe, however, often has parallel hyphae with small projections (diverticulae), which do not usually occur in *Marasmius* sensu stricto. (See Fungi of Queensland for a full description.)



***Cryptomarasmius* sp. broom cells on the** pileipellis. **© Frances Guard.**

***Cryptomarasmius* sp. stipe cells. © Frances Guard.**

While apparently grouping in *Marasmius* morphologically, molecular study, which only began in 2009 for the genus *Marasmius*, showed sect. *Hygrometrici* to be on a very long unsupported branch (Tan et al. 2009). Tan used only the nrITS gene region, and had to leave this result as a bit of a mystery. To resolve the dilemma, further study by Jenkinson et al (2014) used another gene region (nrLSU), which generally has better resolution at the generic level, in their analyses. Jenkinson et al looked at a broad dataset of Agaricales and their analysis took this group out of Marasmiaceae altogether and placed it in the family Physalacriaceae. Only four species were tested but they were resolved as a monophyletic clade. Others have been added to the genus since 2014 from Turkey, Eastern Russia, India and Korea.

Cryptomarasmius is a cosmopolitan genus, with species from the tropics, subtropics and temperate regions of both hemispheres. The type species (*Cryptomarasmius corbariensis*) is from France. I have found fungi which fit into *Cryptomarasmius* in Dilkusha Nature Refuge, South-East Queensland, but like other LBMs, they appear to be an unnamed species. Recent sequencing reveals that the Queensland taxon is indeed a *Cryptomarasmius* and in a clade sister to *C. crescentiae* and *C. aucubae*, which occur in far eastern Russia and Thailand. Further study of these diminutive macrofungi may well show more species in Australia and a much wider distribution of the genus. Meantime the species from Dilkusha is waiting to be published.

References

Jenkinson, T.S., Perry, B.A., Schaefer, R.E. and Desjardin, D.E. (2014). *Cryptomarasmius* gen. nov. established in the Physalacriaceae to accommodate members of *Marasmius* section Hygrometrici. *Mycologia*, **106:** 86–94.

Tan, Y-S., Desjardin, D.E., Perry, B.A., Vikineswary, S. & Noorlidah, A. (2009) *Marasmius* sensu stricto in Peninsular Malaysia. *Fungal Diversity* **37:** 9–100.

Degradation of Polyethylene by Wood Decaying Fungi

David Holdom

A recent article in the journal Plos One describes the degradation of low-density polyethylene by fungi, notably *Phlebiopsis flavidoalba* and a species of *Xylaria*.

Once again fungi come to the fore as metabolic powerhouses with great potential for use in bioremediation.

The study was from Sri Lanka, but both *Phlebiopsis* and *Xylaria* occur in Australia and it is highly likely that our species will have similar abilities. For those interested the reference is below, along with a recent one on systematics of the genus *Phlebiopsis.* Both are open source and so freely available.

References

Perera P, Herath H, Paranagama PA, Wijesinghe P, Attanayake RN (2023) Wood decay fungi show enhanced biodeterioration of low-density polyethylene in the absence of wood in culture media. PLoS ONE 18(7): e0288133. https://doi.org/10.1371/journal.pone.0288133

Ya-Nan Zhao, Shuang-Hui He, Karen K. Nakasone, K. L. Wasantha Kumara, Che-Chih Chen, Shi-Liang Liu, Hai-Xia Ma and Man-Rong Huang (2021) Global phylogeny and taxonomy of the wood-decaying fungal genus *Phlebiopsis* (Polyporales, Basidiomycota) https://www.frontiersin.org/articles/10.3389/fmicb.2021.622460/full

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Fungal Taxonomy
Part One – Ancient Origins

Vanessa Ryan

Introduction

Over the past decade or more there has been an increase in the number of people talking about fungi. Fungi have become very popular in some circles (some even say sexy) and it seems that everywhere I turn there are people extolling the importance of the stuff. Yet, in almost the same breath, and with just as much fervour, it is announced that for all their potential virtues we know very little about these amazing organisms and that only a very small percent of what is out there has been described and named.

In July of 2021, I attended the Australasian Systematic Botany Society's annual conference. That week-long event demonstrated clearly to me how fungal taxonomy in Australia is lagging far behind that of plants.

I found myself thinking about this more deeply while I was writing my report on the conference, which was published in The Queensland Mycologist Vol. 16 Issue 2-3. I had a number of questions that I felt needed answering.

The result is a series of articles which document my musings and research as I traced the development of fungal taxonomy through time.

As I understand it, at its very basic level taxonomy is about the *naming* of things, making *descriptions* of those things for identification purposes and how the concepts of those things are *organised* to understand or use them better.

In this, Part One, I look into the deep past to see whether or not the ancient people who were the forefathers of our Western civilisation had developed and used any form of fungal taxonomy. In Part Two, I will examine the next thousand or so years of history and the development of the science of fungal taxonomy as we know it today. In Part Three, I will focus on fungal taxonomy in Australia – its past, present and future.

Is fungal taxonomy really lagging behind plant taxonomy?

The first question I had to ask myself was: do we really know so little about our fungi in comparison to our plants? I had to remember that the ASBS conference was a *botanical* conference and so naturally the greater proportion of presenters would be botanists and not mycologists. My perception may have been skewed by that, but when I thought about it some more I realised that what was niggling me was that most of the botanical talks were about the *analysis* of data, whereas the basis of most of the mycological presentations was about the *gathering* of data.

More recently (June 2022), I viewed a dozen or so of the presentations given online for the Mycology Colloquium by the Fungal Network of New Zealand. This was a purely mycological event and the analysis of data was key to the talks. Even so, it appeared to me that getting enough data to work with was often a difficult task for the mycologists – due to lack of specimens in herbaria, not enough information about the species in question, and having to work with species that were as yet undescribed and unnamed. In the course of some of the studies new species had even been discovered, but due to lack of funding or time or both, these species remained unpublished. I found this disturbing as only about a third of an estimated 20-24,000 New Zealand species have been formally described and named.[1]

It seems that Australian fungal taxonomy is in an even worse position. According to the Taxonomy Australia website and Wikipedia, it has been estimated that there are 50,000 to a possible 250,000 fungal species in Australia. Of those, somewhere between 5 and 25% have been described and named.[2 3]

Those same sources also say that Australia has 25,000-30,000+ species of vascular plants, of which 90% have been formally described and named.[4 5]

The numbers and percentages for each group are very uncertain, but when you compare the two groups, it is very clear that the vascular plants are
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indeed the winner when it comes to taxonomic attention.

In 2020, Martin Cheek and colleagues undertook a world-wide review of the numbers of new species of plants and fungi that were published in 2019.[6] Cheek found that: "Numbers of new species in both kingdoms were similar with 1,942 new species of plant published and 1,882 species of fungi. However, while >50% of plant species have likely been discovered, >90% of fungi remain unknown. The fungal kingdom is significantly less well studied than the plant kingdom."

So that answered my first question. I am not imagining things. The science of mycology really is lagging behind botany, not only in Australia but also in the rest of the world.

Why is fungal taxonomy lagging so far behind plant taxonomy?

I believe the answer to that question is very long and complicated. To even attempt an answer, I needed a better understanding of how the science of mycology began and developed.

A very, very long time ago…

I was surprised at how far back in time my research led me.

From the very beginning, all human cultures have had to gather knowledge about the natural world around them just to be able to survive. The way that people describe and categorise this common and localised knowledge is referred to today as "folk taxonomy". It is from folk taxonomy that scientific taxonomy was ultimately developed.[7]

Folk taxonomies typically used classifications to create categories based on obvious morphological features or cultural usage and level of usefulness of a particular item. For example, the size of a plant determines whether it is a "tree" or a "shrub", or its use determines whether it might be an "herb" or a "weed". Categorising terms such as these are all a part of everyday language.

There are also levels of specificity within folk taxonomy. It begins with very broad concepts and filters down to specifics. For example, the top level might be "fungus", the next level "mushroom", the next "bolete" and the final level "cep". All these words can be used to talk about the same thing. The meaning of the words just become more and more specific as it travels down through the taxonomic levels.

The words used to name things are typically localised. Using the above bolete again as an example, in some English speaking areas it is known as a "cep", while in others the same mushroom may be referred to as a "penny bun", "porcino" or "porcini".

The folk taxonomies of ancient Asia and the Americas are well documented to have included fungi, however, my interest here is the development of the system of Linnaean-based taxonomy that we use today, here in Australia. It was developed in Europe and its roots are in the Near and Middle East, and so I needed to begin my search for answers there.[8]

Some of the oldest possible physical evidence of ancient Europeans having some knowledge about fungi comes from the skeletal remains of a prehistoric woman nicknamed "**The Red Lady of El Mirón**". She died around 18,700 years ago and had been buried in the El Mirón Cave, Spain. Embedded in her dental calculus, along with other microparticles of foodstuffs such as seeds and tubers, were the spores of both bolete and agaric species.[9] From this it has been inferred that mushrooms were a part of her diet.

Another and more oft-used example to demonstrate early human usage of fungi is **Ötzi the Iceman**.[10] Ötzi is the name given to the mummified body of a man who had died around 5,300 years ago in the Central Eastern Alps on the border of Austria and Italy. He had been carrying two different species of fungi with him at the time of his death. One of the fungi is a polypore (*Fomes fomentarius*), a species known to have been used for tinder in fire-making and also as a stiptic for treating wounds. The other fungus is another species of polypore (*Fomitopsis betulina*) and it is thought this may have been used for its medicinal qualities as a laxative for worm treatment.[11]

It can be postulated, then, that The Red Lady and Ötzi, or someone they had interacted with, knew how to identify fungi and knew which ones were safe to eat, could treat ailments and were useful in fire making. Fungi were a part of each of their regional folk taxonomies.

As for lichens, there is evidence that people from a number of different early European cultures have been using them for thousands of years for food and medicine and in making dyes, cosmetics, incense and perfumes.[12] [13] The traditional knowledge of the **Sámi** people of northern Europe recognises that lichens are different to mosses and divides them into three different generic taxa and numerous specific taxa.[14]

Where am I going with this? Well, it demonstrates to me that fungi and lichens have been used in Europe for many, many thousands of years. Over that time

quite a large knowledge base would have been built up about them, knowledge that would have had to have been passed down via an oral method as writing hadn't yet been invented. When writing did come along, there was a wealth of fungal knowledge ready and waiting to be transcribed.

It didn't take me long to discover that the ancient scholars who wrote about fungi and lichens considered them to be "simple" plants. This is quite understandable given the level of investigative technology that was available at the time, and so they were studied along with the various trees, shrubs, grasses and herbs.

Fungal taxonomy, in the beginning, was plant taxonomy.[i]

I was rather surprised, then, when I read in Barbara Thiers' book, "Herbarium*",* that only a very few fungi and lichens are mentioned in those first texts written about plants.[15] Why was this so? Do those early texts provide the answer?

Who were the first people to write about fungi and taxonomy?

The Mesopotamians

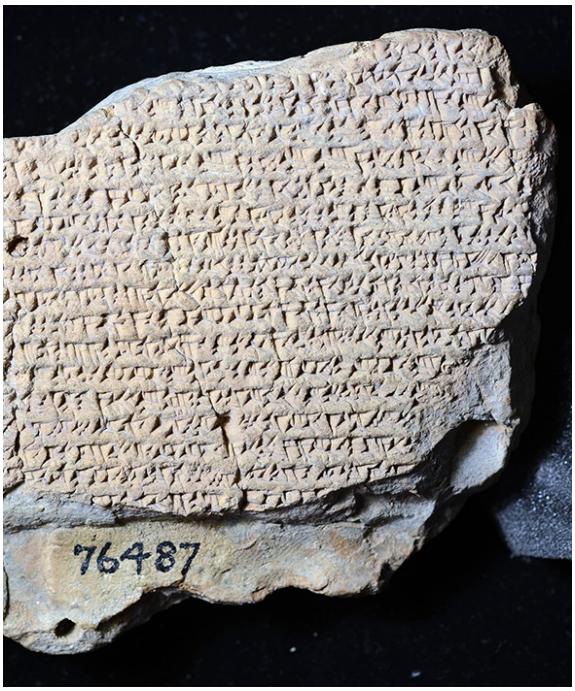
The ancient Mesopotamians (roughly modern day Iraq) invented many things that are basic to our Western civilisation – things such as the wheel, agriculture, mathematics and writing. (It is thought that they invented writing about 5,500 years ago.) Fortunately for us, the Mesopotamians wrote on durable clay tablets, a great many of which have survived to this day.

One such clay tablet which has been found and translated contains the names of the herbs and vegetables which grew in **the garden of Merodach-Baladan II, king of Babylonia** (722–710, 703–2 BC). This list of names, divided into fifteen sections, is thought to be arranged to reflect the different beds in the garden. There are 67 plants, including five different kinds of mint. Since this is a list of deliberately grown feature plants, I wasn't surprised that it doesn't include any fungi or lichens. Interestingly, many of the plants that are listed are known to have medicinal qualities, so it is possible that this is an early physic garden.[16] Gardens such as this were important places and the remains of many grand gardens have been found associated with ancient Mesopotamian palaces and temples. Their kings filled them with not only local plant species, but also plants taken from distant lands as the spoils of war. These gardens were not only used for pleasure, but were also sources of ingredients for medicines, and places where student physicians could learn to identify the plants they used in their remedies. Thus, it could be said that they were a tool of taxonomy. (As botanical gardens are today.)

The use of herbal medicines was highly developed in ancient Mesopotamia and it is known that physicians from across the ancient world went there to study in their centres of learning. Many clay tablets and fragments have been found that contain lists of the names of plants alongside descriptions of the ailment they were used to treat. The contents of the tablets are arranged in one of two ways, either by the plant, or by the ailment that was to be cured. These primitive herbals are thought to have been used as teaching aids and references. The oldest that has been found was written some time around 1200 BC.[17]

One of these herbals, a set of four (or possibly more) tablets, is known as the **Uruanna** or **Irianna: maštakal** (meaning 'the plant whose home is heaven is the plant maštakal').[18] The Uruanna was compiled from a collection of much earlier texts by the Assyrian king Ashurbanipal some time between 650 and 600 BC.

At the end of the herbal are the following comments which describe both its contents: "… contains drugs, which since the times of old have not been systematically redacted in commentaries and



Fragment of the Uruanna. Frahm, E. & Frazer, M. & Jiménez, E., 2013, "Commentary on Dām nēši (excerpts from Uruanna) (CCP 6.5)," Cuneiform Commentaries Project (E. Frahm, E. Jiménez, M. Frazer, and K. Wagensonner), 2013–2022; accessed December 11, 2022, at https://ccp.yale.edu/P461289. DOI: 10079/59zw43z.

i It is not until only very recently (1969) that fungi were given their own kingdom separate from plants.

explanatory texts", and its author: "Ashurbanipal, king of the universe and king of Assyria, checked all those drugs and their equivalents that had been indiscriminately lumped together without applying any criterion as far as the sequence is concerned and he for the first time arranged methodically these drugs and their equivalents."[19]

The tablets contain lists of medical ingredients, some of which are of animal and mineral origin. The far greater proportion (340) are plants and, to my delight, some fungi.[20] Ashurbanipal thoughtfully included an average of four alternative names for the plants, as well as an occasional brief description and notes on how and where they grew. I managed to find an English translation of tablet III on the internet.[21] If I understand the translation correctly, I counted five possible references to fungi.

The content of the tablets appears to have been arranged by different criteria. On the first tablet, a number of plants known to be aquatic in nature are listed together. Elsewhere, some plants are associated by colour, while others are thought to have been grouped together because their names sound similar – for example, *urnû*, *qurnu* and *ḫurnu*.[22] [ii]

The ancient Mesopotamians used special indicators at the start or end of written words (determinatives) which helped to clarify the meaning of the word. These indicators may or may not have been spoken.[23] It is thought by some that their use could have created a rudimentary form of taxonomy by indicating categories, as items (not only plants) with the same determinatives often placed together in lexical (word) lists.

Another (incomplete) set of tablets, also dating from some time in the first millennium BC, is known as the **Šammu Šikinšu** (meaning 'the appearance of the medicinal plant')*[24].* As its title indicates, this herbal contains descriptions of plants, details about their habitat, and which ailments they were used to treat. It then explains how to prepare and administer the concoctions.

The Šammu Šikinšu has also been translated into English[25] and, reading through it, I found a remedy that possibly uses a fungus as an ingredient: "The plant whose appearance is like (that of) the field-clod-plant, whose fruit is red – that plant is called earth's-phlegm-plant; it is good for the rectum. You dry it, pound it and mix it with oil, (then) you make a suppository out of this, insert it in his rectum and he will be cured." The translator believes that "earth's-phlegm-plant" could possibly be a jelly fungus, but I'm not convinced.

Other tablets and fragments have been found that possibly belonged to even more herbals. The plants they list have been grouped together by the diseases and illnesses they were used to treat. It is thought that herbals such as these were used as training or reference materials, as this organisational structure made it easier for medical practitioners to quickly look up which plants were used to cure a certain complaint.[26]

Many of these herbals were copied over and over down the centuries. You would expect that the number of known medicinal plants would grow over time and be added to the list, but it didn't. Surely the Mesopotamian physicians would have, through either trade with distant lands or experimentation, discovered new plants to add to their medicine cabinets? It seems not, for the texts kept to the same rigid format, describing more or less the same species each time with only the information about those plants slowly growing in detail.[27] Such is the level of detail that a few of the listed plant species have been able to be identified by modern botanists.

Another important collection of tablets is one of the world's oldest dictionaries – the **Urra = hubullu**, which means "interest-bearing debt". That's a strange title for a dictionary, but that is a translation of the first two words on Tablet 1. The complete work is thought to be composed of up to twenty-four tablets and it was repeatedly copied with various alterations over many hundreds of years. The final version was seemingly made around 1200 BC – after that it changed very little. The dictionary is a bilingual (typically Sumerian and Akkadian) list of words, organised thematically.[28]

I found it interesting that the trees and reeds are listed on tablets apart from the rest of the plants, but looking at how other items are listed (e.g. clay with pottery, leather with leather goods), it does make sense. The trees are followed on the next tablet by wooden objects and the reeds by reed implements.

I was curious as to how the plants were organised within their sections. Fortunately for me, the Urra = hubullu was, apparently, very much used as a tool for teaching scribes to write and a great many fragments of the text copied by students have been found. I found a translation of one of these exercise tablets, which has nine lines from Tablet 3 copied onto it.

ii Could this have been a legacy from the time when this information was passed along orally? Rhyming is a common mnemonic technique.

“grape cluster
grape cluster
grape leaf
small grape leaf
offshoot of a grapevine
fig (tree)
fig
offshoot of a fig tree
apple” [29]

What was immediately noticeable was that the words were arranged within the list in what I could regard as a somewhat logical order and the ordering followed a repetitive pattern.

It’s time I now return to my my original questions about fungal taxonomy. What had my research revealed?

It can be said with some certainty that the ancient Mesopotamians thought that fungi were plants. They collected the names of plants and they recognised that the same kind of plant could have many different names. They wrote descriptions of the plants they knew and used by comparing their parts to other plants. They made organised lists of the plant names by classifying and then grouping them according to different criteria.[30]

However, it seems to me that the ancient Mesopotamians were simply recording and re-recording down the millennia their already existing folk knowledge. In part that may be because the earlier descriptions were already in a convenient format, but they did not add to that knowledge base by giving names to or describing as yet unknown plants. All they did was collect and transfer their ancient oral folk taxonomies to a written version.

It may have been only a small step, but even so it was one that had to be made and so it was a step in the right direction.

The Egyptians

Ancient Egypt is another great civilisation that influenced the people of southern Europe. It invented its writing system around 5,000 years ago[31]. What did the ancient Egyptians have to say about fungi?

I searched my resources (mostly the internet) for many days and I found the same brief pieces of information repeated over and over again. I suspect it all came from the same, unreferenced source. The blog, “Crazy about Mushrooms”, (which did cite their source[32]) seemed to have the best compilation of this information: “The ancient Egyptians called mushrooms “sons of the gods” and “plants of immortality” and thought that the storm god Set created them by hurling lightning bolts coated in mushroom-seed to earth.”[33]

So it seems that, like the Mesopotamians, the ancient Egyptians thought that fungi were plants, albeit mysterious and of heavenly origin.

Also like the Mesopotamians, the ancient Egyptians were excellent agriculturalists and there is a lot of evidence to show that they also loved gardening.[34] [35]

The remains of over 2,000 different species of scented or flowering plants have been found preserved in tombs.[36]

Archaeologists have found the remains of many elaborate gardens. Some of the first ever botanical gardens were created by Queen Hatshepsut and her co-ruler, Pharaoh Thutmose III, some time around 1500 BC.[37] Like the kings of Mesopotamia, Thutmose had his wide-ranging military expeditions send many species back home. A record of these campaigns survives in two rooms of the Temple of Karnak as bas-relief wall carvings. Such are the large numbers of exotic plants and animals depicted that the rooms have been named the **Botanical Garden**. There are no images of humans or any writing on these walls, nor is there any attempt at portraying the plants and animals in a landscape. Some think that this may be a pictorial catalogue of the exotic species which had either been observed in distant lands and carefully recorded or possibly those that had been brought back to Egypt as the spoils of war.[38] The images of the plants are greatly stylised – perhaps to highlight the significant and identifying characteristics of the plant. To a people whose hieroglyphic writing system is pictorial, would these stylised images have more meaning to them than they do to us?

The tomb of a government official called **Ineni** (dated somewhere between 1550–1295 BC) contains a written list of the names and numbers of plants that grew in his formal garden. A translation of this list[39] contains the names of twenty different species, including trees, vines and other plants. This list format is apparently quite unusual. Other tombs have landscape paintings of plants in gardens and avenues, or refer to plants by name in prose. It is not known if the order in which Ineni’s plants are listed was random or a deliberate representation of some sort of classification system.[40] Many of the species in the list have been identified. I looked them up and all are used for either timber, food or medicine.

The names of hundreds of plants are mentioned on other stone monuments and in the ancient literature (official records, letters, stories, poems).[41] Did the ancient Egyptians try to put all these plants into any kind of systematic order in a botanical text?

Like the ancient Mesopotamians, when writing the ancient Egyptians used determinatives to clarify the

meaning of certain words.

A papyrus found in the remains of the mortuary temple of the pharaoh Ramesses the Great (the **Ramesseum onomastic papyrus**) may be the earliest surviving record of a knowledge organisation system[42] arranged according to semantic categories[43]. It has been dated to around 1800 BC, making it older than the Urra = hubullu. Its text is written in numbered horizontal lines with the various item's determinatives listed in a separate sub-column. Its contents include one of the oldest known lists of plant names. Unfortunately that section of the papyrus is now mostly illegible, but it can be seen that a determinative which looks like a tuft of grass groups together the names of herbaceous plants.[44]

So the ancient Egyptians had, like the Mesopotamians, developed a kind of dictionary in which there is an organised list of plant names, grouped together by various categories. Did they also have herbals containing the plants' descriptions? From the evidence that has been uncovered, it is highly likely.

Many ancient Egyptian medical texts contain explanatory notes (glosses) that are extremely formulaic descriptions of medicinal plants. It is thought that the scribes, whenever they came across an unfamiliar plant name in the medical text, copied across the plant's description from a botanical textbook or herbal.

These formulaic descriptions follow an obviously pre-established sequential method for presenting botanical information and are thought to be by some incontrovertible proof that the ancient Egyptians had some kind of botanical reference text from as far back as around the middle of the second millennium BC.[45] Betro, in her paper "Herbals in Ancient Egypt", summarises the descriptive formula thus:[46]

"a) name of the plant, any synonym or foreign name ("Una plant: its name is …" or "The plant N: ... ");

b) description of the habitat ("It grows in many places"; "It grows in gardens" or precise locations: "It grows in el-Kharga region");

c) botanical description (general appearance, stem, leaves, flowers, if any petals, fruits or seeds and other minor details, such as presence of thorns, fluff, etc., any measures; bearing);

d) time and method of harvesting ("When you see that its leaves are similar to 'white wood', so it must be harvested");

e) uses and methods of preparation;

f) side effects or if harmful ("If you put his milk on the skin of a man, it causes inflammation")."

I found it very interesting that the ancient Egyptians had used virtually the same method of describing plants and how to use them medicinally as the Mesopotamians. Mesopotamia is the slightly older civilisation and Egypt is known to have imported many of its ideas from there[47]. Was this one of them?

The **Ebers papyrus** is perhaps the most famous of the ancient Egyptian medical documents, being the most complete and the longest to have survived. (It's 20.23 metres long and 30 centimetres wide.) It was written around 1550 BC and, like the Mesopotamian Uruanna, it is a carefully compiled collection of earlier works. Also like the Uruanna, it includes the recipes for a large number of medicines. The medicines use 328 different ingredients and most of those are derived from plants.

I found a translation[48] [iii] of the Ebers papyrus and it contains a long list of those plant-based ingredients. If I understand correctly, the author of the translation had rearranged the contents of the papyrus for his discussion, so I unfortunately don't know the ordering of the original text. Also, I couldn't see anything that was obviously fungal other than some very frustratingly vague mentions of "yeasts" associated with beer and wine. I was left wondering if the term "yeast" was a proper translation of the original ancient Egyptian text or a modern concept that the translator had placed upon it. In ancient Egypt, there simply weren't the tools available to be able to see micro-organisms like single-celled yeasts and so the ancients were unaware of their presence in things.

Fragments of another ancient Egyptian list of plants survives on a dozen or so scraps of a papyrus, dated from somewhere between 332 BC and 284 AD. The list is titled "**Seeing all plants of marsh and field** (?)..."[49] Another reference I found to this partial papyrus translated the title as "Survey of all field plants" and states that the text "specifies their properties, probably for therapeutic use."[50] It is tempting to think that such a list might have included fungi and lichens.

In 332 BC, Egypt was conquered by Alexander the Great and the Greek Ptolemaic dynasty was established. For three hundred years there was a high level of cross-cultural exchange between the two ancient civilisations. Greek and the Egyptian

iii The book is more a discussion on the contents of the papyrus and not the direct translation that I would have preferred.

demotic script were often used side by side – a practice which continued when Egypt became part of the Roman Empire (30 BC – 641 AD).

Scraps of texts, written in Greek on papyri and dating from the first and second centuries AD, have been found in the remains of the **Tebtunis temple library**. A number of these scraps are thought to have come from an illustrated herbal. The herbal was written in columns with the name of the plant, a coloured image of the plant underneath, followed by a short description of the plant and then the medicinal details and instructions. There are also the remains of two copies of an herbal written in demotic. The plants were sequentially numbered by the ancients for easy reference, which is quite different to previous herbals.[51] From the numbering in the surviving text, at least ninety plants had been described.[52]

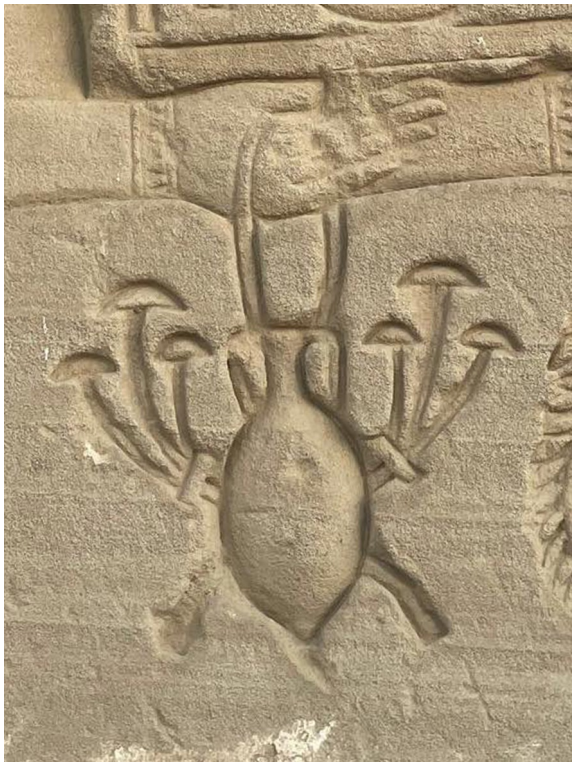
The physicians of ancient Egypt, to greater and lesser degrees, also relied on prayers, magical spells and divination to aid their healing. The "**De virtutibus herbarum**" is an astrological herbal dating from around 400 AD. It focuses on the healing properties of plants believed to be associated with the twelve Zodiacal signs and seven planets. Of more interest to me, is that it is a glossary systematically arranged into twenty-four entries – one for each letter of the Greek alphabet in order.[53] This alphabetical ordering is a very different method from what had been used before and perhaps illustrates a shift of focus from the medical use of the plant to the plant itself.

Two of the plants mentioned in the De virtutibus herbarum are also mentioned in the **Johnson Papyrus**. Also written in Greek and dated to around 400 AD, this scrap of papyrus is also incontrovertibly a fragment of an ancient herbal. On one side is a coloured drawing of a plant that had been labelled as "symphitum" (*Symphitum officinale*, comfrey) and written next to it are eight broken lines of text, which, when translated read: "This plant, when ground down, cures every haemorrhage and agglutinates wounds and severed tendons. It cures coughing up of blood …"[54] [55]

So, summing up, did the ancient Egyptians think fungi and lichens were plants? Yes.

Did they try to put what they knew about plants into any kind of systematic order? Again, yes, depending on how we define systematic – not in the modern use of the term systematics in biology, but as a methodical procedure. The Egyptians used determinatives and other criteria to systematically organise their glossaries and medical recipes.

Johnson Papyrus fragment showing a plant possibly *Symphytum officinale*, comfrey. https://wellcomeimages.org/indexplus/obf_images/a5/de/5df2c559664347f717f39ca97aa8.jpg.



Did the ancient Egyptians cultivate mushrooms? Wall carving, Temple of Hathor, Dendera. Copyright: dakota of earth, https://twitter.com/dakotawint/status/1459591396189429766/photo/2.

Did they write descriptions of plants for identification purposes? Yes, and they used a format that was very similar to the Mesopotamians'. I can't say whether or not this is because the Egyptians copied the Mesopotamians or because they had arrived at the method independently. In later times, the Egyptians copied the Greek method of writing herbals with illustrations.

The civilisation of ancient Egypt spanned a period of around 3,000 years but much of what they wrote has not survived the trials of time. Not all the papyri and sculptured texts found so far have been translated. Perhaps that long lost ancient Egyptian treatise on fungi and lichen is lying quietly on a dusty shelf in a museum somewhere, waiting for someone to translate it. Or maybe it just hasn't been discovered yet. I can only hope so.

The Ancient Greeks and Romans

The Greek **Theophrastus** wrote the "Historia Plantarum*"* (Enquiry into Plants) between 350 BC and 287 BC. It consists of nine volumes and, for this and his other surviving works, Theophrastus is considered to be the father of the science of botany.

He is also the first person known to have used the word lichen ("leikhēn" in ancient Greek) when referring to the growths on the bark of olive trees.[56] (By the way, it was established much later that the growths he was describing were actually liverworts.[57])

I scoured through Hort's English translation of "Historia Plantarum"[58] and I counted six references to fungi and three to lichens scattered throughout the nine books. Hort identified those six fungi and two lichens as:

- "Wheat rust" as *Puccinia graminus*
- "Thunder truffle" as *Tuber aestivum*
- "Truffle" as *Tuber cibarium = Tuber melanosporum*
- "Puffball" as *Lycoperdon bovista = Bovista plumbea* or *Bovistella utriformis*
- Disease on oak trees described as a "knot" as *Polyporus igniarius*? *= Phellinus igniarius*
- "Mushroom" as a fungus
- "Tree moss" as *Usnea barbata*
- "Lichen" as Litmus lichen, *Roccella tinctoria*

Theophrastus doesn't actually describe rust as an organism, but as a condition causing rot of seeds and disease in plants. From what he wrote, he clearly understood that *something* was affecting crops and certain steps could be taken to prevent it from happening:

"Generally speaking, cereals are more liable to rust than pulses, and among these barley is more liable to it than wheat; while of barleys some kinds are more liable than others, and most of all, it may be said, the kind called 'Achillean'. Moreover the position and character of the land make no small difference in this respect; for lands which are exposed to the wind and elevated are not liable to rust, or less so, while those that lie low and are not exposed to wind are more so. And rust occurs chiefly at the full moon."

Theophrastus's other references to fungi are extremely brief. The best described are the lichens and even those are succinct. This is the most detailed:

"The substance which some call tree-moss and which resembles rags is borne only by the *aigilops* (Turkey-oak); it is grey and rough and hangs down for a cubit's length, like a long shred of linen. This grows from the bark and not from the knob whence the acorn starts; nor does it grow from an eye, but from the side of the upper boughs. The sea-bark oak also produces this but it is blackish and short."[59]

The ninth and last book of "Historia Plantarum*"* is often considered to be an "herbal" because of the author's focus on the curative properties of the plants it covers. A 2018 examination[60] of the structure of his plant descriptions was compared to the Šammu Šikinšu and they were found to be virtually identical:

"a) General identification (similarity with other plants or mention of common name);

b) Description of plant morphology [In this order: 1. general remarks; 2. leaves; 3. stems; 4. flowers; 5. seeds; 6. roots; 7. fruits; and 8. special features];

c) Habitat, or place where the plant grows best;

d) Medicinal use (In this order: 1. medicinal properties; 2. modes of administration)." [iv]

This was considered to be quite a significant discovery, as it strongly suggests that Theophrastus was simply copying the Mesopotamians method – or could that have been the Egyptians? It is thought that Theophrastus had been a student of Plato and Plato is said to have studied in Egypt.[61] [62] Or perhaps, had Theophrastus simply copied the style, perhaps even the entries, straight from the Šammu Šikinšu itself? He admitted he referenced other

iv I had a quick look at one of my books on native plants - "Mangroves to Mountains". The plant descriptions followed the same structure, as did the "Flora of south-eastern Queensland". It seems that the tradition possibly established by the ancient Mesopotamians continues to this day.

works (including those of the physician Diocles of Carystus, 375 BC – 295 BC[v]) and he collected descriptions of plants and their uses from travellers.

Could this explain his surprising brevity when he writes about fungi and lichens? That it is because the works he was drawing upon did not contain much about them?

When writing about plants, Theophrastus had attempted to make sense of them by putting them into some sort of overall order.

"Book 1: Plant anatomy
Book 2: Tree and plant propagation
Book 3: Wild trees
Book 4: Trees and shrubs from abroad
Book 5: Wood
Book 6: Undershrubs, with thorns or without
Book 7: Pot-herbs
Book 8: Cereals and legumes
Book 9: Medicinal uses of plants"[63]

Interestingly, in the very first book in the first volume, where he wrote "Of the parts of plants and their composition", he said: "For not all plants have root, stem, branch, twig, leaf, flower or fruit, or again bark, core, fibres or veins; for instance, fungi and truffles; and yet these and such like characters belong to a plant's essential nature." [64] Had he suspected that fungi and truffles were of a different nature to plants?

Hort's English translation of Theophrastus's books has been found to be incomplete.[65] Apparently Hort had deliberately omitted some passages which are concerned with aphrodisiacs and abortifacients, mostly likely due to reasons of keeping to what was socially acceptable at the time. What else might have been left out – or added – over the progression of centuries? [vi]

The ancient Roman known as **Pliny the Elder** (Gaius Plinius Secundus) used Theophrastus's "Historia Plantarum" as a source for the botanical component of his great compilation "Naturalis historia" (Natural History).[66] The first ten of 39 books were published in 77 AD, the rest were published after his death two years later.

Pliny mentions lichens[67] and about fifteen different fungi[68] in his writings.

In book 19, he wrote about truffles: "Among the most wonderful of all things is the fact that anything can spring up and live without a root. These are called truffles (tubera); they are surrounded on all sides by earth, and are supported by no fibres or hair-like root-threads (capellamentis); nor does the place in which they are produced swell out into any protuberance or present any fissure; they do not adhere to the earth; they are surrounded by a bark, so that one cannot say they are altogether composed of earth, but they are of a kind of earthy concretion; they generally grow in dry sandy places which are overgrown by shrubs; in size they are often as large as quinces and weigh as much as a pound. […] Now whether this imperfection of the earth (vitium terrae) – for it cannot be said to be anything else – grows, or whether it has at once assumed its full globular size, whether it lives or not, are questions which I think cannot easily be explained. In their liable [sic] to become rotten these things resemble wood." [69]

In book 22, he writes: "I'll rightly class boletus with the things that people eat thoughtlessly, truly a splendid food but brought into disrepute by one dramatic episode, Agrippina's use of it as a means of administering poison to Emperor Claudius, her husband. This action unleashed another poison, her son Nero, both on the world and on herself. You can easily recognise some of the poisonous ones by the weak red colour, disgusting appearance, the livid colour inside, cracks and the pale margin. However, that's not always the case, for there are those that resemble the good ones, like the one whose crown bears white specks, arising from its own integument." It is highly probable that Pliny was referring to *Amanita muscaria* and *Amanita caesarea*.[70]

In book 29, he gives an antidote for mushroom poisoning: "Hens' dung, provided it is white, boiled down in hyssop or honey wine, is used for poisonous fungi and mushrooms, as well as for flatulence and suffocations – a matter for wonder, because if any animal save man should taste this dung, it will suffer from colic and flatulence."[71]

A contemporary of Pliny was the Greco-Roman Pedanios **Dioscorides.** Dioscorides wrote "De Materia Medica" (On Medical Material) some time in the first century, probably between 64 and 77 AD. No evidence so far has been found that Pliny and Dioscorides ever met or were aware of the other's work.

"De Materia Medica" consists of five volumes. Within the series of books, plants that had similar uses

v Diocles of Carystius was a contemporary of Theophrastus. Unfortunately his works are now long lost and we only know of them through references by other authors of the period.

vi I have the same concern about many of the other ancient texts I am consulting for this article.

were grouped together – for example, those with anti-inflammatory properties.[72]

As with King Ashurbanipal more than half a millennium before him, Dioscorides was determined to create a work that was complete and organised. Unlike Ashurbanipal, he was determined not to just copy the works of others. In the dedication of the work, he wrote: "Although many of the writers nowadays, as well as those in ancient times, wrote discourses on the preparations, strengths and dosage of drugs, I will attempt to prove to you that I did not choose to undertake this through vanity or impulsiveness. Some of those authors did not complete their attempts, while others copied previous historical documents." He names a number of authors and points out their failings: "they completely omitted any systematic discussion of herbs and ignored metals and spices" and "ignored many extremely useful roots and gave meagre descriptions of many herbs". He also states: "that someone wanting to be an accomplished herbalist should observe the first new growths of the herbs as well as their mature expression and their eventual decline. Otherwise a person seeing only a new shoot will be unable to identify the same flourishing plant, and having seen only its full growth will not know the seedling".[73]

In total, Dioscorides mentions 592 different substances used for making medicines and other useful concoctions.[74] Most of these substances are derived from plants, plants which he described in great detail – so well, in fact, that many have been identified by modern botanists.

Dioscorides also added illustrations to his text, but he was not the first to do this. The earliest known illustrated herbal was written some time in the first century BC by **Crateua**, a physician of Hellenistic Pontos, an area that is now in the eastern Black Sea region of Turkey. The original work has been lost to time.[75]

I read through a translation of Dioscorides' work[76] and I counted five recipes with fungal components and two using lichen.

The predominance of fungal mentions are to do with cures for mushroom poisoning – I counted eleven. "De Materia Medica" is an herbal and recipe book for making medicines, so this shouldn't be surprising.

However, there is another entry specifically about fungi (Book Four) which I found most interesting. You may have seen it quoted elsewhere as it is rather memorable.

"Fungi have a double difference for they are either edible or poisonous, and come to be so on many occasions, for they grow among rusty nails, rotten rags, the holes of snakes, or among trees that bear harmful fruits. Such as these also have a viscous coalesced fluid, and stored after they are picked they quickly spoil, growing rotten. Those that are not harmful (boiled in broth) are sweet, yet for all that taken too much they hurt, being hard to digest, choking or breeding bile. All are helped; drenched with nitre and oil, or soaked in a decoction of sharp brine or thymbra, or liquified with origanum, or hen dung with vinegar, or syruped with a quantity of honey. They are nourishing and hard to dissolve, and are put out whole (for the most part) with the excrement." [77]

I can only think that Dioscorides was trying to dissuade people from eating mushrooms and possibly being poisoned.[vii] If that was the case, then why didn't he write about how to identify edible and poisonous fungi? Was it simply too difficult a task for him? Mushrooms were such a delicacy and eaten regularly that there had to be people who knew the lore that he could have learned from. In his dedication, he even made a pointed comment about having spoken with local experts to learn about certain plants.

"With careful investigation – since I know many plants personally, and others from previous writings that are generally approved of – and patiently inquiring (by questioning the local inhabitants) about each type of plant, I will attempt a different classification, and also try to explain the varieties and uses of each one of them."[78]

Was it because the "previous writings that are generally approved of" [viii] didn't mention fungi so he didn't have the information to copy? Or was it just easier to decry them than to try to sort the good from the bad?

He certainly didn't avoid discussing poisonous plants, such as black nightshade. Here we are given an excellent description of the plant, where it is found, how to take it and even how much is lethal.

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vii Dioscorides would have been around fourteen years old when the Roman Emperor Claudius was supposedly murdered by mushroom. Claudius was a well-respected Emperor, at least he was better liked than Nero who succeeded him. And the death of an Emperor certainly would have been big news. Could this tragic event have had an effect on the young man's view of fungi? Just a thought.

viii It is thought by some that Dioscorides may have based his work on the herbal by Diocles of Carystius. https://plantspeopleplanet.org.au/s1/s11/

And I also found his method of describing the plant strangely familiar. For all his proclamations about being better than his fellow authors in his dedication, Dioscorides was still following the, by then, millennia-old recipe for writing herbals.

To sum up Dioscorides' "De Materia Medica", I can say that he definitely did make a good attempt at organising the plants into groups, such as trees, herbs, cereals and vegetables. He was aware of the importance of providing a good description of a plant in all stages of its life and provided descriptions that are good enough for modern botanists to make identifications.[79]

However, the nature of lichens as a group seems to have eluded him – as he placed one with trees and shrubs (Book One) and the other with miscellaneous herbs (Book Four). His single actual description of fungi (and not a cure for mushroom poisoning) is also lumped in with the miscellaneous herbs.

Galen of Pergamon was a Greek physician, surgeon and philosopher, and private doctor to two Roman emperors – Marcus Aurelius and his son, Commodus. He was also a prolific author – possibly hiring up to twenty scribes to record his thoughts.[80] It is thought that he could have produced over six hundred books between 165 and 180 AD, however only around two hundred have survived to this day. Many of us may know Galen as being the father of modern systematic medicine, as his prodigious work was the basis of Western and Islamic medicine until the nineteenth century.

The last six books in the series of eleven volumes that are known as "Simple Medicines" are a catalogue of the plants, minerals and animal products he used. In book six, he assesses his botanical sources, including Dioscorides. Apparently Galen was concerned about the accuracy of plant identifications in the works he drew upon and it appears he had no qualms about accepting Dioscorides'. Unlike Dioscorides, Galen lists the plants alphabetically.[81]

How did the ancient Greeks and Romans contribute to the development of fungal taxonomy?

Once again, they thought that fungi were plants, so fungal taxonomy was plant taxonomy.

When it comes to names it appears that, like the other civilisations before them, they recorded the names that the plants were commonly known by – both in their own language and other languages. Theophrastus made an exception to this when he used the word "lichen" to describe the organism.

The Greeks and Romans were very good at describing plants, but they were more or less following the traditional method that had developed over a millennia. The introduction of illustrations to complement the text was a big innovation.

As for the organisation of the plants, the Greco-Romans appear to have moved from making categories of placing like with like (similar morphological features or medical usages) to an alphabetical sequence.

Dioscorides was not in favour of this practice: "Additionally they have erred in the categorisation of medicines: […], others establish an alphabetical system in their discussions and thus separate types and activities of materials that are similar, so that they become harder to remember."[82]

Perhaps Dioscorides was missing the point – that texts made it no longer necessary to remember everything. Perhaps it also reflected a change in use in texts, from teaching aids to actual depositories of that knowledge. Having the information written down meant that the organisation of that knowledge could shift from making things easier to remember, to making the information easier to find in its new textual format.

Summary

And so I find myself now standing at the brink of what is commonly known as the Dark Ages (500 AD). Before moving on to the next thousand or so years (Part Two), what did I learn about the ancients' contribution to fungal taxonomy?

Folk Taxonomy

Humans have used fungi and lichens from prehistoric times, so a significant knowledge base about them had to have existed before writing was invented. Knowledge was passed along in an oral tradition. It appears to me that the early texts were simply a transcription of that oral tradition. That makes sense as it would be the easiest thing to do.

Their True Nature

The true nature of fungi and lichens was not understood and so fungi and lichens were thought to be plants. For a very long time as a result of this misunderstanding, fungal taxonomy was plant taxonomy. Thus, to look at how those different societies developed and used taxonomy, the only ancient texts I could refer to were about plants as they understood them.

Micro-fungi

Before the invention of the microscope, micro-fungi could not be properly recognised for what they were, even though their effects on crops and timber and diseases of animals and people greatly impacted many lives. When micro-fungi are mentioned in

ancient texts, it is as a condition, rather than an organism.

Discovering

Effort was made via trade and military endeavours to gather information about and, in many cases, import previously unknown but useful plants from other civilisations. Those plants weren't truly "undiscovered" species as they were already a part of the folk taxonomy of the trading or invaded culture. I found no mention of an attempt to discover truly unknown plants.

Naming

Other than Theophrastus being the first to call lichen "lichen", I didn't find any reference to any other plant or group of plants being given a new name. It appears that the ancients used the names that the plants were commonly known by in their folk traditions. Some made the effort to discover and record the names of the same plant in dialects and languages other than their own and produced a synonymous list. New plants from other regions were referred to by their traditional names from those regions.

Describing

There is a very strong similarity in the way the scholars of the different civilisations wrote their descriptions of plants. Typically, it is something like this:

a) The name of the plant.

b) Habitat, or place where the plant is known to grow best. (This may be at the end of the description.)

c) A general description, usually of gross morphological features and any similarity with other plants.

d) Description of the plant's features, listed in a particular order, going from the obvious and most enduring features to the least: leaves, stems, flowers, seeds, fruits, roots.

e) Anything unique about the plant.

f) Medicinal properties (if in an herbal).

It is unclear to me who developed this method first, but it is obvious that it has been used for an extremely long time.

Categorising

Plants were typically organised in lists or glossaries according to the need of the user. In medical texts, the system was by the plant or by the ailment to be treated. In lexical texts, they were organised into categories such as: similar gross morphology, where they grew, what they were used for. These categories were possibly legacies from the region's system of folk taxonomy. Eventually, as the emphasis of learning moved away from remembering knowledge to looking up that knowledge in texts, items began to be listed alphabetically.

Conclusion

I believe that the biggest contribution that the people of ancient Mesopotamia, Egypt, Greece and Rome made to fungal taxonomy was to move their existing folk taxonomies from an oral tradition to a lasting written record, and to attempt to consolidate all that information into single sources for reference.

But the question remains – why aren't there many references to fungi and lichens in those ancient texts?

I've often heard it said that mycological knowledge was "secret" knowledge that the ancient mystics and shamans kept to themselves and that's why so much of the information about fungi was never written down. If that was the case, I must then ask why weren't the plants that also have hallucinogenic, poisonous or healing qualities treated in the same manner? From what I saw in the translations I read, many of those plants seem to have freely entered the herbals of the ancient physicians.[ix]

I've also heard it said that it is because mycological knowledge was women's business and men in ancient times – particularly in Greece and Rome – considered women secondary citizens who either had no knowledge worthy of a man's interest, or it was beneath an educated man's dignity to ask a woman for information.[83] [84]

Now, there is a great deal of historical evidence to support the role of women in plant gathering and agriculture from as far back as the Stone Age. Ethnobotanists have concluded that the women of many cultures world-wide were the primary holders of botanical (and mycological?) folk knowledge.[85]

Each of the civilisations I have discussed had female scholars, herbalists and doctors and it was the people who had these occupations who are the most responsible for texts about plants. The female doctors of both Mesopotamia and Egypt were highly respected.[86] Despite the fact that women were considered of lesser status in ancient Greece and Rome, some esteemed female doctors are mentioned in Greek and Roman texts and, from these texts, it can be seen that it was not unusual for these women to also be scholars and authors.[87] [88] [89] I find it difficult to believe that a female physician

ix Remember Dioscorides' extremely detailed entry on Black Nightshade?

would hesitate to discuss plants with a wise woman who was the holder of the local folk knowledge.

However, the authors of the Greco-Roman works that I have discussed in this article are all men. (The majority of all ancient works that have survived were written by men.[90]) I can't rule out the possibility that there was indeed a gender bias as to the source of their information.

There may have also been another bias at play here, intentional or otherwise, and it is one that may have also influenced the female scholars of the time. In one of his books, Galen makes a, what I think is very interesting, comment about mushrooms:

"One finds that the learned man who discourses on the natures of things, knows their nature. But if any mushrooms are placed before him, he does not know which are edible and which are not, whereas the country-dwellers can distinguish between them since they are familiar with them and see them constantly, and even the children know them, to say nothing of their elders."[91]

This is part of an argument Galen was making about the value of experience over theory, but is he also touching on the reason why the ancient scholars such as himself didn't write more about fungi?

It was only the wealthy who could afford to be educated and learn to write. It was only the wealthy who had the luxury of not having to work for a living and had the time in which to write. (The ancient scribes, who wrote for a living, usually made copies of existing texts or wrote what they were told to write by others.[92]) Was it because the wealthy "learned man" (or woman) of the city simply didn't enter into discourse about mushrooms with the poor and illiterate country folk?

Or was it because fungi and lichens were simply not understood? I have also heard this said as possibly being the reason why fungal taxonomy is so far behind plant taxonomy. It could be so, as it appears to me that the ancient scholars – from Mesopotamia to Rome – were trying to understand these organisms by using the same highly formalised method that they used for plants. It's because fungi and lichens aren't plants that this system of investigation breaks down. Were they put into the "too hard" basket because of this?

Theophrastus wisely wrote: "[...] since it is by the help of the better known that we must pursue the unknown, and better known are the things which are larger and plainer to our senses, it is clear that it is right to speak of these things in the way indicated: for then in dealing with the less known things we shall be making these better known things our standard, and shall ask how far and in what manner comparison is possible in each case. And when we have taken the parts, we must next take the difference which they exhibit, for thus will their essential nature become plain, and at the same time the general differences between one kind of plant and another."[93]

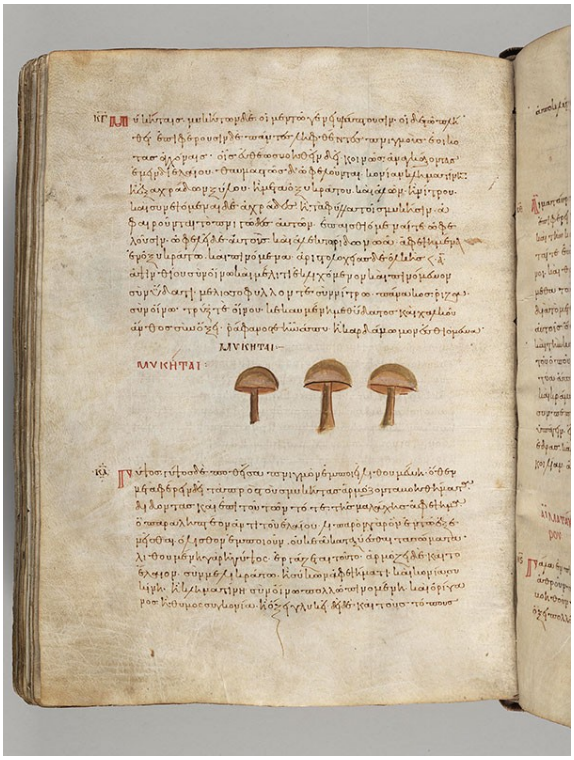
In short, Theophrastus was saying that scholars should start with the known and understood, then try to understand lesser-known things from the framework of this knowledge. However, was he also implying that the ancient scholars, himself included, were still very much at the first step of getting to know the plants that "are larger and plainer to our senses"?

The fact that the ancient scholars were pretty much all using the same method for describing plants brings me to the subject of copying. Before the printing press was invented the only way to preserve written knowledge was to copy it over and over by hand, and this was the work of scribes. It was up to the scholars to try to put the information in to some kind of order, according to their individual needs.

There certainly would not have been the wealth of data that our scholars of the present day have to work with. There would have been only a handful of texts on a certain topic, such as botany, for scholars to learn from. The words of these few texts and the opinions of those who wrote them would have had to have had much greater impact on those who read them.

"De Materia Medica" became one of these defining works. It became the go-to herbal text throughout Europe and the Middle East for well over the next 1,500 years. It was translated from Greek into Latin, Italian, Spanish, English, German, Assyrian and Arabic. It was also the basis of many other herbal works which came afterwards. So great was Dioscorides' influence on medicine and herbals that modern scholars have a name for it – the "Dioscoridean tradition".[94] [95] I am left wondering if Dioscorides' disparaging words about fungi were unconsciously or consciously picked up and continued by those – such as Galen – who sourced his work? Was Dioscorides' opinion responsible for later scholars shunning those deceptive and dangerous fungi? That may be the case for what came after Dioscorides, but that doesn't explain why so few fungi and lichens are mentioned in texts before Dioscorides.

I had to look at the numbers again – the number of fungi and lichens compared to plants. But… I also had to remember that the ancients considered fungi and lichens as just another kind of plant. Was that the key to all of this?



Page from a mid 10th century copy of De Materia Medica from Istanbul, Türkiye.The Morgan Library and Museum, http://ica.themorgan.org/manuscript/page/512/143825

The plant species that were written about were mostly those which were deemed important – for food, medicine, fibre and building material – or those that were a weed in crops or poisonous to humans and livestock.

For example, Theophrastus mentions about 500 species in his Historia Plantarum.[96] That is a large number of species, but recent estimates put the total number of plant species in the Mediterranean area at around 25,000.[97] Why did Theophrastus choose to write about those particular 500 species? The answer to that is easy – information about them was readily available and it would be of communal benefit to preserve and disseminate that knowledge. They were important to humans.

It is no wonder that Theophrastus chose to write so much about staple food plants such as wheat (he mentions at least seven different varieties) and barley (five varieties) and timber trees such as pine (three species) and oak (nine species).[98]

Although some fungi were cultivated for food (**Nicander of Colophon**, 185 BC, described how fungi were farmed in one of his poems – Georgica)[99], they couldn't be grown as a staple crop for large populations. Nor did they store well as they rotted quickly. Only a very few fungi appear to have been used in medicines. Similarly, lichens couldn't be grown as a crop and only a very few species were found to be useful.

Ferns have a similar story. They are mostly inedible and only a few were used in medicine. Interestingly, Theophrastus's meagre number of five or so species of fern is comparable to his six fungal species.

Could the answer as to why not many fungi and lichens were written about really be that simple? That they weren't included because they just weren't deemed important enough.

I asked some questions, read a lot of material and found some answers. Maybe.

The trouble is, I was working from limited material.

Many times while researching this article I came up against pay walls or my occasional emailed questions to experts remain unanswered because, I suspect, I am not a student or a professional working for an organisation. (This is not a complaint – I understand these experts would have heavy workloads.)

But the bigger picture is that the experts themselves might not know the answers to my questions. So much information about these ancient civilisations has been lost through time. Clay fractures and turns to dust, papyrus and paper fragment and rot. Thieves steal and deal precious texts, scattering them so that they lose context and meaning. Lack of funding and lack of archaeologists to do the work mean that texts that might have survived the rigours of time simply haven't yet been found. Of those that have survived, some are distant copies of an original work and are liable to have mistakes or omissions, whether through accident or design. On top of that, many of the texts that have been found simply haven't yet been translated or published – again due to lack of funding and translators. They lie untouched and even forgotten in private collections, museums and universities scattered around the world.

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