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Beginner's Guide to Fungi Identification

Laetiporus sulphureus (Chicken of the woods)

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INTRODUCTION

- This presentation is aimed at an audience with varying levels of knowledge about fungi and aims to provide **guidance on how to identify gill fungi, using features observable in the field**.

- The first few slides provide a brief introduction to fungi and a background to **why fungi appear where they do**. This should help you **understand where you might find different species and what they might be growing on**.

- There are also some images of fungi lacking gills but related to gill fungi and of other unrelated macro fungi.

- The rest of the material relates to **gill fungus identification in the field**.

A BRIEF INTRODUCTION TO FUNGI

- Like animals, **fungi need an intermediary (plants, cyanobacteria) to extract energy from the sun**
- They have evolved various **lifestyles:**
  - **Symbiotic**: a complex (e.g. mycorrhizal) relationship with plants
  - **Saprophytic**: decompose organic matter
  - **Parasitic:** infect living hosts

Mycorrhiza:

- A **partnership between fungi and plants through the finer plant roots**
- Allows the partners to **exchange photosynthetic products (sugars) from the plant and soil nutrients and water from the fungus**.
- **A-Mycorrhiza:** The fungus hyphae penetrate the cell wall, but not the cell membrane of the root.
- **Ectomycorrhiza**: most important for fruitbody-forming fungi, hyphae do not penetrate the root cell but surround them.

LACCARIA AMETHYSTINA
(AMETHYST DECEIVER)
WITH FURROWED UMBILICATE
PURPLE CAP AND THIN STEM

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FUNGI TYPES

Symbiotic Fungi

- >90% of plants form mycorrhizal relationships with fungi: most of these are with largely nonfruiting species which live in soil.
- Some are ectomycorrhizal genera that produce big, showy fruitbodies: Amanita, Russula, Lactarius, Cortinarius, Boletes sp., Inocybe, Tricholoma, ...
- …and there are the lichens.

Saprophytic Fungi

- They have a wide range of sizes (fungi and fruitbodies): single-celled yeasts to an Armillaria species where a single organism has been found to extend over a kilometer-sized area.
- They can decompose almost any organic substrate
- Some are specific in requirements, others are less choosy

Saprophytic Fungi (continued)

- They frequently fruit in large numbers: Agaricus, Mycena, Clitocybe, Peziza, Inonotus, Lepiota, Pluteus, Coprinus., ...

Parasitic Fungi

- Many plant diseases are fungal: rusts, smuts, mildews
- Several fungal genera: Cordyceps, Entomophthora, Laboulbeniales…attack insects
- Some fungi trap nematodes and other microfauna: Pleurotus, Hohenbuehelia, Hyphoderma, Laccaria
- ...and then there are the “aggressive saprophytes” the most notorious of which is Honey Fungus (Armillaria sp.).
- Some are human parasites.

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THE UK FUNGAL KINGDOM

- In the UK there are something like **15,000 species of fungi**
- About **3500 UK species** are **Basidiomycetes**
  - All **produce spores on basidia** (club shaped spore-bearing apparatus) **and drop their spores**.
  - Of these around **3000 are "larger fungi "** (which are what are known as mushrooms and toadstools).
  - As well as the **gilled fungi** (Agarics) there are **Polypores, Clavarioids, Corticioids** and **Jelly Fungi.**
  - There are also **other groups, including Earthstars, Stinkhorns and Puffballs**, that **produce their spores internally**, **or release them in a slimy or powdery mass.**
- There are also around **2000+ species** of **Ascomycetes,** excluding mildews.
  - **Ascomycetes** produce their **spores in bag-shaped asci**. When they mature, the **spores are ejected by osmotic pressure**, which can shoot them several centimetres.
  - Although **some are large, many are microscopic**.
  - Larger species include the Xylarias (candle snuff, dead man's fingers), Bulgaria (black bulgar), Pezizas, Helvellas (white saddle, black saddle) and Morels.

SUBSTRATE & ASSOCIATION

Substrate

What fungi grow on (so where you can look for them) depends on whether they are symbionts, saprophytes or parasites.

Examples could include:

- a living or dead tree trunk
- a rotten log
- soil
- leaf litter
- a leaf
- dung
- another fungus
- all sorts of other things

Association

If you can identify an organism associated with the fungus, it may help to identify it.

- Some symbiotic fungi are restricted to mycorrhizal associations with particular plant genera or species.
- Saprophytic fungi may be generalists while others may be restricted to certain species or genera.
- Parasites tend to be host specific, so if you know the host, you may be able to identify the species.

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BASIDIOMYCETES WITHOUT GILLS (1):

POLYPORUS TUBERASTER
(TUBEROUS POLYPORE)
WITH CAP AND ANGULAR PORES

PHAEOLUS SCHWEINITZII
(DYER'S MAZEGILL):
POLYPORE WITH ROSETTE-SHAPED FRUITBODY

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BASIDIOMYCETES WITHOUT GILLS (2):

TRAMETES GIBBOSA
(LUMPY BRACKET):
POLYPORE WITH ELONGATED PORES

POLYPORUS BADIUS
(BAY POLYPORE)
WITH SMALL, REGULAR PORES,
OFTEN FOUND IN LARGE GROUPS

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BASIDIOMYCETES WITHOUT GILLS (3):

PHAEOCLAVULINA ABIETINA (GREENING CORAL) : MULTIBRANCHED CLAVARIOID

PHLEBIA RADIATA (WRINKLED CRUST): RESUPINATE CORTICIOID WITH WRINKLED SURFACE

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BASIDIOMYCETES WITHOUT GILLS (4):

EXIDIA PLANA (WARLOCK'S BUTTER): JELLY FUNGUS WITH WRINKLED SURFACE

ABORTIPORUS BIENNIS (BLUSHING ROSETTE) POLYPORE THAT WEEPS DISTINCTIVE RED DROPS FROM A WHITE POROID SURFACE

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BASIDIOMYCETES WITHOUT GILLS (5):

CALOCERA VISCOSA (YELLOW STAGSHORN): CORAL-LIKE, BRANCHED JELLY FUNGUS

GEASTRUM TRIPLEX
(COLLARED EARTHSTAR)
WITH AN OUTER SKIN THAT SPLITS AND PEELS BACK INTO A STAR SHAPE, LEAVING A COLLAR

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BASIDIOMYCETES WITHOUT GILLS (6):

LYCOPERDON PERLATUM
(COMMON PUFFBALL)
WITH WHITE POINTED SPINES

SPARASSIS CRISPA (WOOD CAULIFLOWER):
POROID WITH CLAVARIOID APPEARANCE,

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BASIDIOMYCETES WITHOUT GILLS (7):

PHALLUS IMPUDICUS (STINKHORN) RELEASES SPORES IN SMELLY, SLIMY MASS, DISPERSED BY FLIES

CRUCIBULUM LAEVE (BIRDSNEST FUNGUS) SPORES ARE PRODUCED INSIDE "EGGS" WHICH ARE DISPERSED WHEN RAINDROPS FALL ON THE CUPS

SOME LARGER ASCOMYCETES

OTIDEA BUFONIA:
(TOAD'S EAR)

NEOBULGARIA PURA
(BEECH JELLYDISC)

OTIDEA ONOTICA
(HARE'S EAR)

SPATHULARIA FLAVA
(YELLOW FAN)
RED DATA LIST
SPECIES

XYLARIA LONGIPES
(DEAD MOLL'S
FINGERS)

HELVELLA CRISPA
(WHITE SADDLE)

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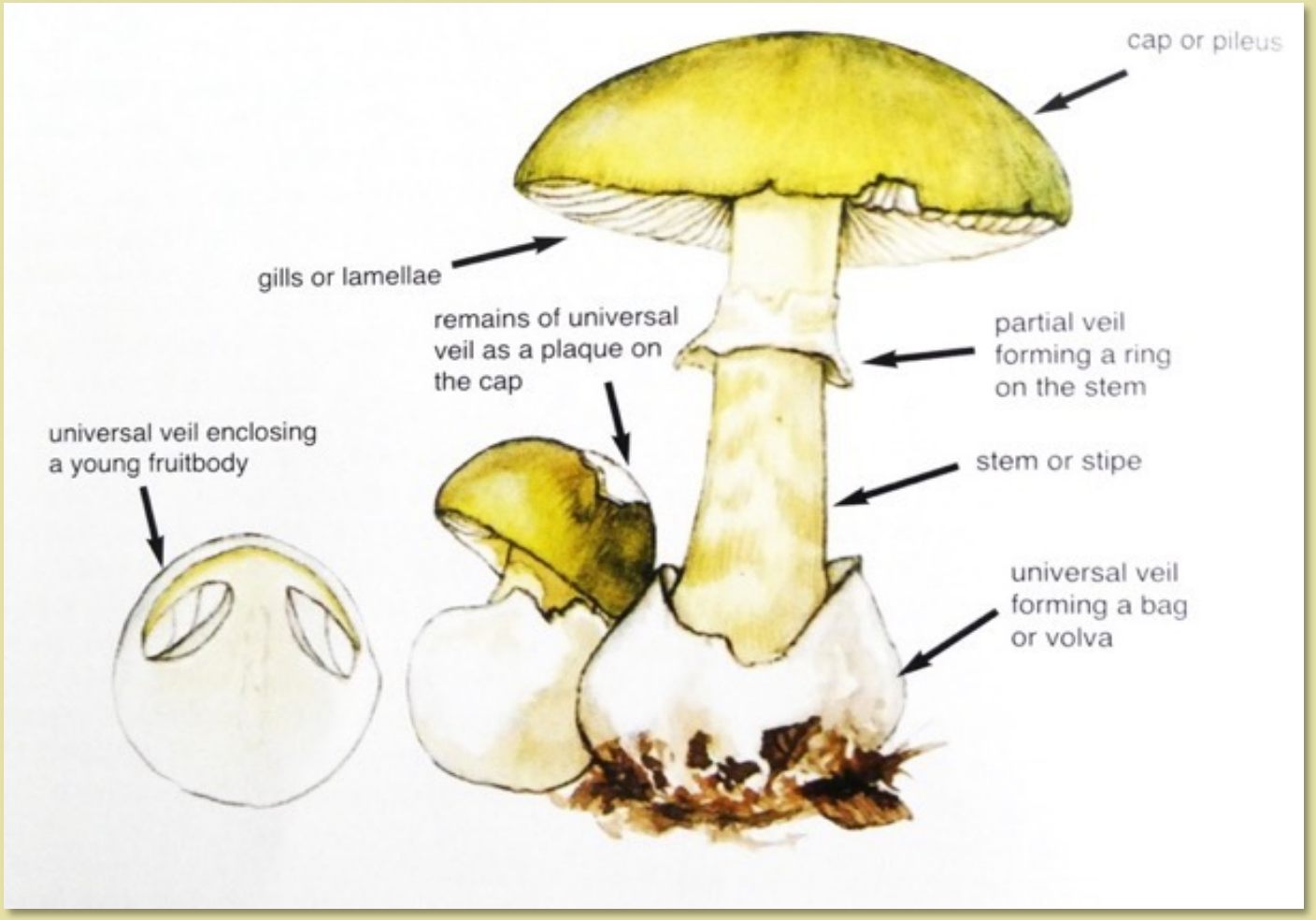
GILLED FUNGI: TYPICAL FRUITBODY



Reference: " Mushrooms and Toadstools of Britain and Europe - Volume 2: Agarics - Part 1", (Kibby)

GILLED FUNGI: VEILS

The Universal Veil

- A protective universal veil covering the entire young fruitbody
- Absent in many fungi
- It can be membranous, thread-like or slimy
- When the universal veil breaks down, the remnants can be left on the stem, the cap, or both
- If membranous, the veil remnants can be left as a bag–like structure at the stem base: the volva

The Partial Veil

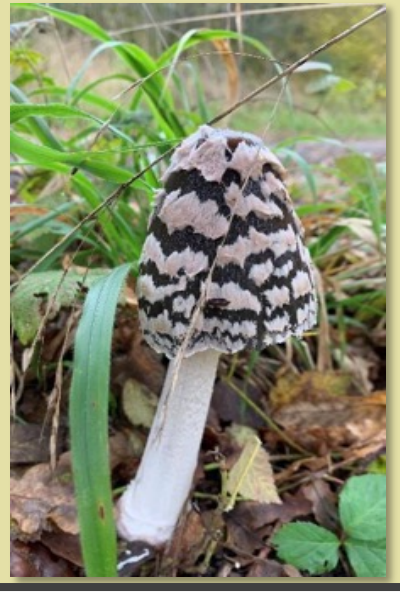
- Cap and stem fungi can also have a partial veil which connects the stem to the margin of the cap.
- Remnants of this can be seen as a ring (or just a ring-zone) on the stem, or as teeth on the cap margin.

Amanita phalloides (Deathcap): showing remains of universal veil as a basal volva

MORPHOLOGY (1)

Shape, Size and Colour

- Cap
- Stem
- Stem attachments (ring/volva)
- Gills
- Spores



COPRINUS PICACEUS (MAGPIE FUNGUS): BELL-SHAPED CAP WITH VEIL REMNANTS

The Cap –Shape

- Conical
- Hemispherical
- Convex (high or low)
- Campanulate (bell-shaped)
- Umbilicate (with a central depression)
- Funnel-shaped
- Flat
- Umbonate (with a hump in the centre)
- Pleurotoid (stem absent or offset to side of cap)

MORPHOLOGY: CAP SHAPES

Cap Shape: Examples

INOCYBE RIMOSA S.L. (PROBABLY): WITH FIBROUS UMBONATE CAP

CONOCYBE APALA (MILKY CONECAP): WITH CYLINDRICAL/CONICAL WHITE WRINKLED CAP

MYCENA SPECIES: WITH FURROWED, CONICAL CAPS

CRATERELLUS CORNUCOPIOIDES (HORN OF PLENTY): FUNNEL-SHAPED CAP

MORPHOLOGY: CAP FEATURES (1)

Cap Features: Examples

HYGROPHOROPSIS AURANTIACA (FALSE CHANTERELLE): WITH FELTY CAP AND DECURRENT GILLS, IT GROWS WITH CONIFERS

MUCIDULA MUCIDA (PORCELEIN FUNGUS): WITH HEMISPHERICAL, STICKY CAP

MORPHOLOGY: CAP FEATURES (2)

Cap Features: Examples

CHLOROPHYLLUM RHACODES (SHAGGY PARASOL): WITH SCALY CAPS AND CLAVATE/BULBOUS STEMS

COPRINELLUS MICACEUS (GLISTENING INKCAP): CAP SUBGLOBOSE-OVOID WITH MICA-LIKE GRANULES

MORPHOLOGY (2)

The Stem –Shape

- cylindrical/equal
- club shaped
- tapered (up or down)
- abruptly bulbous (the stem flares out into a bulb)
- marginately bulbous (there is a distinct margin between the stem and bulb
- rooted or radicant

UNIDENTIFIED FUNGUS WITH TUFTEDGROWTH

The Ring

It is absent in many species and where present, it may be vestigial or cobweb-like or take on a number of different forms:

- **moveable**, if it is only loosely joined to the stem
- **superior**: peels upwards
- **inferior**: peels downwards
- **intermediate**: at right angles to stem and doesn't tear easily either up or down.
- **volvate**: ring is wrapped around the stem base
- **double**: a ring with a cottony roll of tissue on the underside

MORPHOLOGY (3)

Cap and Stem – Size

- The range of cap and stem sizes for a particular species are generally listed in literature.
- For the cap, the relevant measurement is the diameter: for the stem it is the height from the point where it emerges from the substrate to where it attaches to the gills
- Cap diameter is used as one of the factors used in a common key for Russulas (Brittlegills).
- Care needs to be taken to make sure that the specimen being measured is reasonably mature.
- The quoted sizes do not take account of “monster” specimens that occasionally occur: this year I’ve seen a Parasol mushroom with a cap around 30% larger than the maximum that any standard literature suggests!!

Cap and Stem– Surface

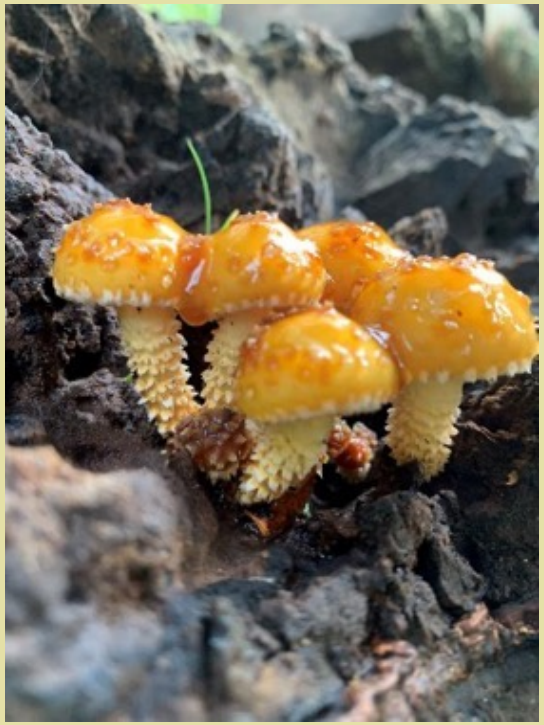
The cap and/or stem may be:

- smooth
- wrinkled
- hairy
- felty
- scaly
- grooved/partly grooved
- granular
- sticky
- slimy

MORPHOLOGY: STEM FEATURES (1)

Stem Features: Examples

AMANITA RUBESCENS:(BLUSHER): FLAT CAP WITH VELAR REMAINS AND STEM WITH RING



PHOLIOTA FLAMMANS(FLAMING SCALYCAP): CAP CONVEX-UMBONATE, STICKY WITH, STEM AND CAP WITH YELLOW SCALES

MORPHOLOGY: STEM FEATURES (2)

Stem Features: Examples

LEUCOAGARICUS LEUCOTHITES (WHITE DAPPERLING): CONVEX-FLATTENED CAP AND STEM WITH INFERIOR RING

LECCINUM AURANTIACUM (ORANGE BOLETE): CAP HEMISPHERICAL WHEN YOUNG, MORE CONVEX WHEN MATURE, STEM WITH BROWN "SCALES"

GILLS (1)

The Gills

- Are the gills crowded, close, or widely spaced?
- Are there intermediate gills?
- Are they deep or shallow (thin/thick)?
- What colour are they?
- Are the gills mottled?
- Are the edges coloured?
- Do the colours change as they mature?

MYCENA SPECIES:
BOTH FULL-WIDTH AND
INTERMEDIATE GILLS PRESENT

GILLS (2)

The Gills – Attachment to Stem

- **Free**: not joined to stem
- **Adnexed**: joined for part of gill's depth
- **Adnate**: joined for entire depth of gills
- **Decurrent**: running down stem
- **Emarginate**: with curved notch where stem meets gills
- **Attached**: gills attached to collar around stem

LACTARIUS SPECIES (POSSIBLY *L. RUFUS*): WITH FUNNEL-SHAPED CAP AND DECURRENT GILLS

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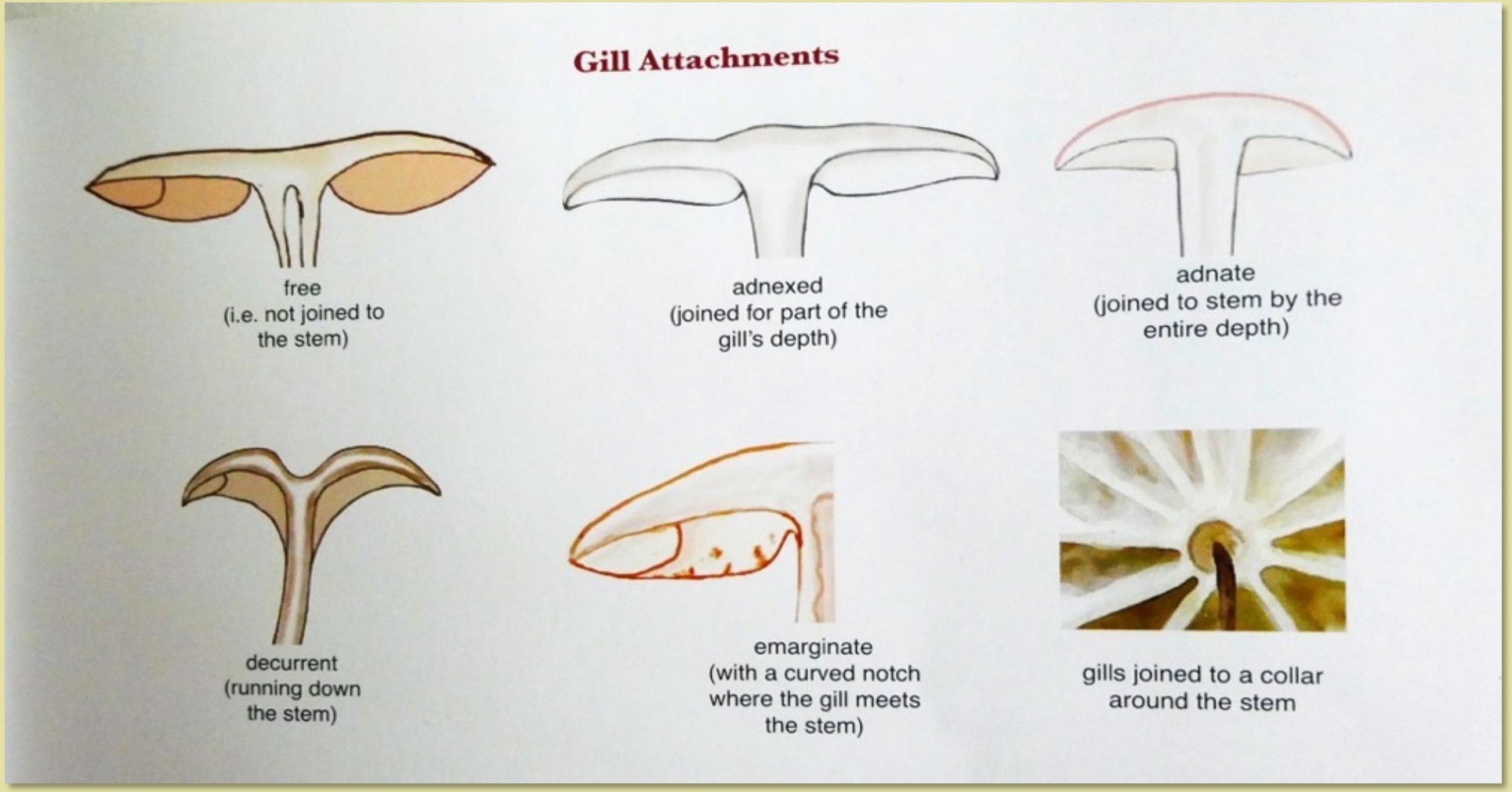
GILLS (3)



Reference: " Mushrooms and Toadstools of Britain and Europe - Volume 2: Agarics - Part 1", (Kibby)

NOTES ON COLOUR

Colour and Colour-change

- **Colour change on bruising or cutting** is probably the most significant character used to distinguish species of Boletes.
- In the Russulas (Brittlegills), with more than 150 UK species, the first stage of a widely-used key is to consider **cap colour**. Another stage of the key differentiates between species with a flush **of colour in the stem** and others where this is absent.
- The **colour of the exudate ("milk")** from some of Lactarius (Milkcap) species when the cap is cut or broken, can be used to separate species. In some cases, **colour change when the milk dries** can also be significant.
- A few Mycenas (Bonnets) exude **coloured liquid from the cap and/or stem when cut or damaged**: e.g. white - *Mycena galopus* (Milking Bonnet), dark red - *Mycena haematopus* (Burgundydrop Bonnet) and orange - *Mycena crocata* (Saffrondrop Bonnet).
- There are a number of **chemical tests that are helpful in fungus identification**. For example, testing Russula stems with a ferrous sulphate crystal can produce pink or green colouration.

RUSSULA SARDONIA (PRIMROSE BRITTLEGILL): WITH CONTRASTING COLOURS IN CAP AND STEM

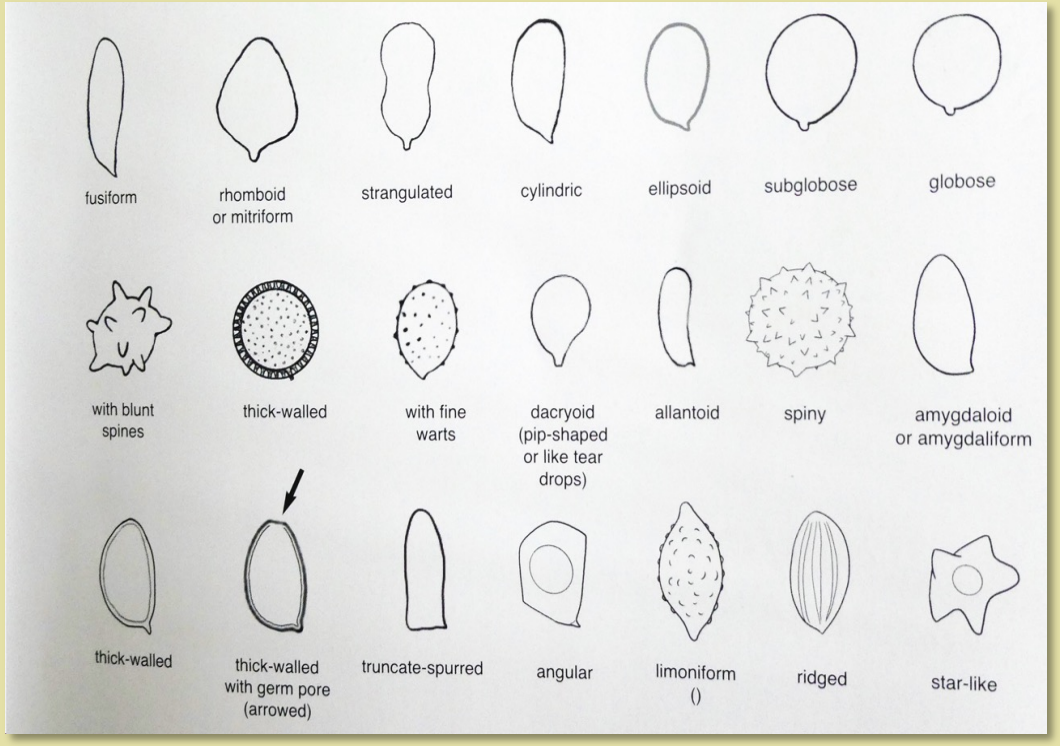
LACTARIUS CONTROVERSUS (BLUSHING MILKCAP): CAP STAINS WINE-RED AS IT AGES

SPORE COLOUR & SHAPE

Spore Colour

- **Spore colour can differentiate** between a number of groups of fungi.
- Colours **range from white, through cream and yellow to ochre, mid brown, dark brown and black.** Some spores are also **pink**.
- **Gill colour is not an accurate predictor of spore colour**. The best way to determine this is to **place a mature, but not-overmature fungus cap onto a glass slide, or white paper in a closed container to allow spores to drop.** This will take several hours. The spore deposit can then be scraped up into a pile to determine the colour.
- **Colour is not the only way in which spores can help with species identification**. In the **microscope**, they also vary considerably in **size, shape and ornamentation**, which can be diagnostic. (see opposite)

Basidiomycete spore shapes and ornamentation



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SEASONALITY & GROWTH

Seasonality

- Some fungi growing on wood can be found almost all year.
- Many fungi are distinctly seasonal. Most large fungi appear in autumn, depending on rainfall.
- Certain of the larger Ascomycetes, such as Morels appear in the spring and early summer, as does the appropriately-named gill fungus: Spring Fieldcap.
- Others, including the Clouded Agaric and the Buttercap, tend to be late-season fungi.
- Some fungi seem to depend on frost to stimulate fruiting.

Growth Habit

Are the fruitbodies:

- Solitary.
- Grouped.
- Growing in a ring
- Trooping – separate but growing over a wide area in large number.
- Tufted/Clustered - growing from a common base.

MYCENA RENATI (BEAUTIFUL BONNET) CLUSTERED FRUITBODIES WITH CONICAL/CAMPANULATE CAPS
RARE IN UK

TASTE & SMELL

Taste and Smell

- Some fungi have distinctive smells including flour, bedbugs, aniseed, insecticide, or gas tar, among many others, so worth a try in case!
- Some fungi have a particularly strong smell and can be detected by smell, before they are seen e.g. Stinkhorn
- A test for distinguishing species of Brittle gills (Russulas) is by tasting a small piece of gill to see whether it has a mild, acid or bitter taste.
- Similarly, the taste of the “milk” produced by Milkcaps (Lactarius species) can also help to identify them.

LEPIOTA CRISTATA (STINKING DAPPERLING) WITH CAMPANULATE SCALY CAP WITH A SLIGHT UMBO AND DISTINCTIVE SMELL

SUMMARY

Summary

You will give yourself the best chance of identifying a fungus from field characters if you collect the following information.

Appearance: colour, shape, size and texture,

Growth habit: single, trooping, clustered, etc.

Smell: floury, aniseed, bleach, fruity, etc.

Substrate: tree trunk, soil, leaf litter, etc.

Association: tree, plant, another fungus, etc.

Habitat: deciduous woodland, grassland, heathland, urban, etc.

PARASOLA LEIOCEPHALA (BALD INKCAP) WITH FLATTENED UMBILICATE FURROWED CAP

LACCARIA LACCATA (DECEIVER) WITH SLIGHTLY UMBILICATE CAP AND GRANULAR CAP SURFACE

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NEXT STEPS

Literature

While there is quite a lot of information on fungi online, it is strongly recommended that you have access to at least one fungus identification book. There is a recommended list of books on fungi included below. I have all of them.

Microscopy

If you have access to a microscope, you can take the next step, which is to collect and examine the spores, which vary enormously in size and shape and ornamentation, such as spines, warts and ridges as well as colour (discussed earlier, in the section on spores). These features can be used in many cases to identify, or confirm the identity of fungi. The same is true of the shape and size of other structures, such as hairs.

Fungus Groups

A recommended way to develop your fungus knowledge would be to join a fungus group. There are a number of these affiliated to the British Mycological Society, two of which hold surveys in the Basingstoke area, separately or together: the **Hampshire Fungus Recording Group** and the **Thames Valley Fungus Group**. I'm a member of both. There are no entry requirements other than an interest in fungi and subscription rates are modest and members include those with a range of knowledge and expertise. Beginners and the less-experienced are welcomed.

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READING LIST

Suitable for beginners:

- Collins Complete Guide to Mushrooms and Fungi: Sterry P. & Hughes B. 2009 (paperback) £16.99
- Collins Fungi Guide: Buczacki S. & Shields C. 2013 (paperback) £19.99
- Mushrooms: Phillips R. 2006 (paperback) £30.00

More advanced:

- Mushrooms and Toadstools of the British Isles Vols 1-4: Kibby G. 2020-2023 (hardback) Individual volumes: £27.95-£41.95
- The Genus Agaricus in Britain : Kibby G. 2014 (paperback) £17.50
- British Boletes with keys to species: Kibby G. 2016 (paperback) £22.00
- British Milkcaps –Lactarius and Lactifluus: Kibby G. 2016 (paperback) £22.00
- The Genus Amanita in Britain : Kibby G. 2016 (paperback) £17.50
- The Genus Russula in Great Britain with synoptic keys to species: Kibby G. 2017 (spiral binding) £24.99
- The Genus Tricholoma in Britain : Kibby G. 2017 (paperback) £16.00
- Fungi of Temperate Europe. Vols 1-2: Laessoe T. & Petersen J.H 2019 (hardback) £90.00

(Prices from Pemberley Books 03/10/2023)