

# Lichens: Hybrid organisms

Lichens are considered to be "cousins" of fungi because, traditionally, they are made up of a combination of a **fungus** and either a **green algae** or a **cyanobacterium** or both. This association is called **symbiosis**, the fungus is a **mycosymbiote**, and the algae a **photosymbiote**.

Lichenized fungi belong mainly to the **Ascomycetes** (*Ascomycota*). Only a few lichens are formed from **Basidiomycetes** (*Basidiomycota*). As for algae, 90% of them are green algae, mainly *Trebouxia* (50 to 70% of lichens) and *Trentepohlia*. The rest is represented by **cyanobacteria**, of which the genus *Nostoc* is the most common. But this association is much more complex (see [Lichens, surprising pioneering organisms](#)).

## 1. How is a lichen built?

In gelatinous lichens such as *Lathagrium*, the fungus and cyanobacteria are homogeneously mixed : we speak of a **homeomerous structure** (Figure 1). In other lichens, the two partners are distributed differently to form a **so-called heteromerous structure**. In foliose lichens, for example, the structure shows layers (heteromerous stratified structure).

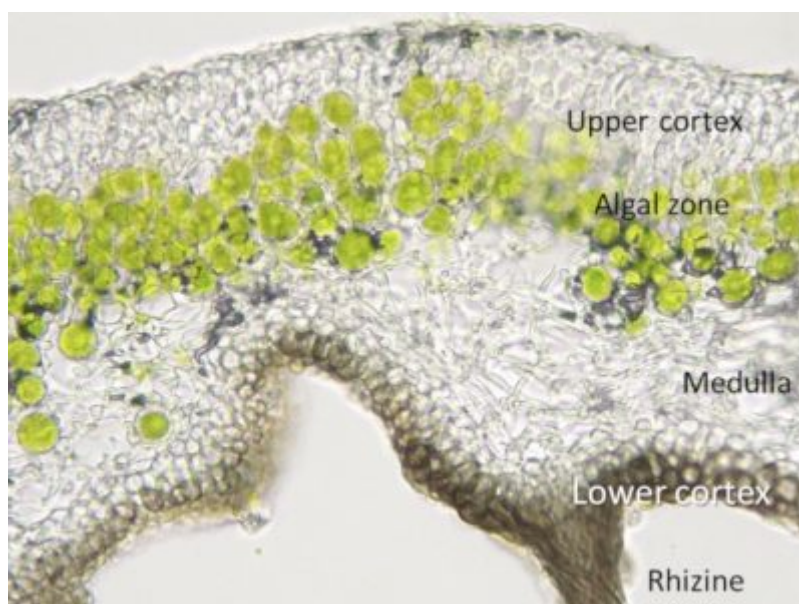


Figure 2. Heteromerous structure. Vertical section of foliose thallus of *Phaeophyscia orbicularis*. [Photo source © Danièle Gonnet]

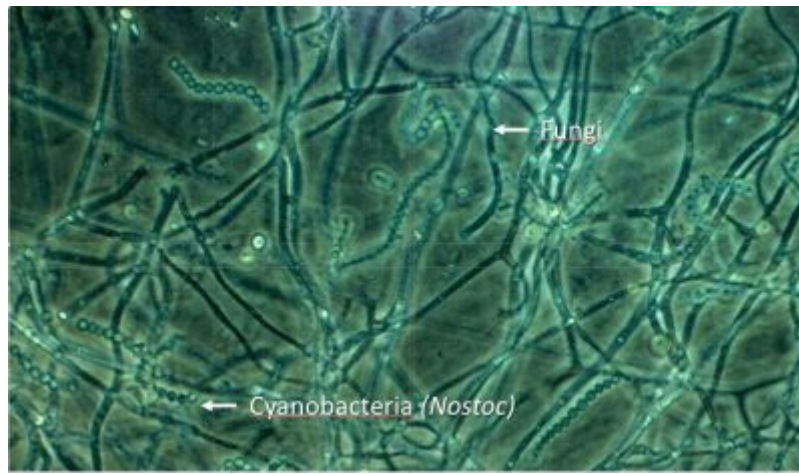


Figure 1. Homeomerous structure of *Enchylium tenax* with gelatinous thallus [Source: document © J. Asta]

On a vertical section of the thallus, we recognize from top to bottom (Figure 2):

- an **upper cortex** formed only by fungi;
- an **algal zone** where fungi filaments and algae cells are intertwined;
- a **medulla or medullary layer** [1] where there are only fungi filaments;
- a **lower cortex** formed only by fungi from which escape filaments or **rhizinae** used to fix the thallus on the substrate.

## 2. Birth of a lichen

Two modes of reproduction can take place: vegetative and sexual reproduction.

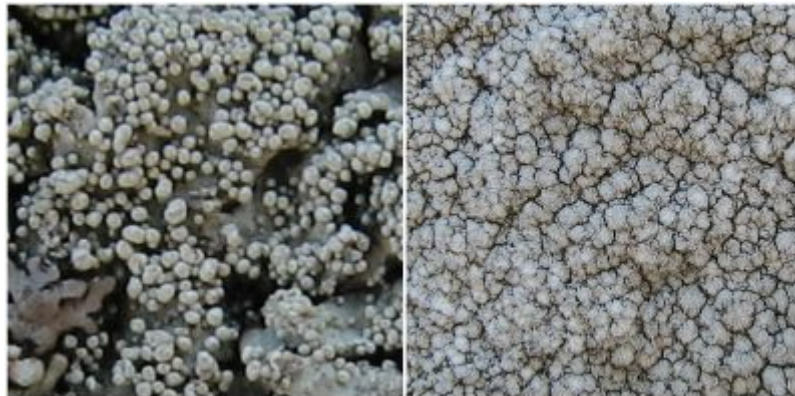


Figure 3. Vegetative propagation: left, isidia from *Parmelia saxatilis*; right, *Lepra amara* thallus with soredia [Source photos © J. Asta]

Vegetative propagation is carried out by fragmenting the thallus or by means of natural cuttings. In *Lepra amara*, for example, the thallus is dotted with floury spots, soralia. At each soralium, the cortex is interrupted and dusts -formed by the fungus filaments and algae- or soredia escape, which can be carried by rain, wind, animals, etc., and thus spread the species. The isidia come from small expansions of the thallus whose cortex persists. When thallus strips rub against each other or insects pass through, these isidia can detach and also be used for dissemination (Figure 3).

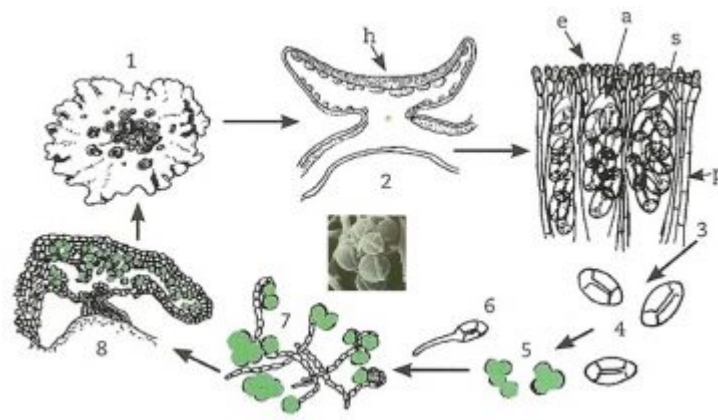


Figure 4. Example of the development cycle of *Xanthoria parietina*. 1: adult thallus with apothecium; 2: vertical section of an apothecia, showing the hymenium (h); 3: detail of the hymenium in section (e: epithecium ; p: paraphyses ; s: spores ; a : asci); 4 : mature spores from the hymenium ; 5 : algal cells (*Trebouxia*) ; 6 : spores in germination ; 7 : primordial stage of the thallus ; 8 : thallus in the process of differentiation. [Source: drawings © J. Asta]

The algae divides only by mitosis (asexual reproduction), only the fungus has **sexual reproduction**. Let's take the example of *Xanthoria parietina* (Figure 4). The reproductive or apothecium organ has a fertile or hymenium tissue consisting of asci where the spores originate. Each asci contains 8 spores with 2 unicellular lodges separated by an equatorial thickening giving the spores an hourglass shape. Between the asks are sterile or paraphyses filaments, the coloured end of which extends beyond the top of the asks and constitutes the epithecium.

At maturity, the spores are violently expelled from the ascus then germinate on the substrate forming mycelial filaments. For a lichen to recover, the mycelium thus formed must meet a single algae. A new thallus can therefore be rebuilt and give back an adult thallus. The symbiosis then gradually recovers.

## Notes and references

**Cover image.** *Xanthoparmelia conspersa*. [Source: © J. Asta]

[1] In crustose lichens, the medulla consists of loosely packed hyphae that are inseparable from the substrate.

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