



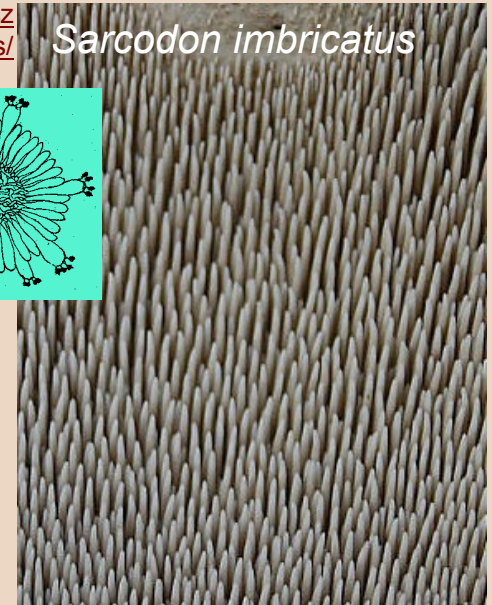
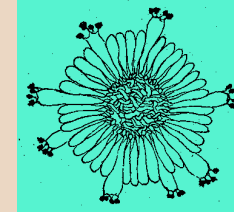
OBEČNÁ MYKOLOGIE

(místy se zvláštním zřetelem k makromycetům)

- Vymezení pojmů „houby“ a „mykologie“ • Historický výskyt a teorie o původu hub
- Stavba houbové buňky (cytoplazma, organely, jádro a bun. cyklus, bun. stěna)
 - Výživa a obsahové látky hub • Vegetativní stélka hub (nemyceliální houby, hyfy, hyfové útvary, pletivné útvary, stélka lišejníků, růst houbové stélky)
 - Rozmnožování hub (vegetativní, nepohlavní, pohlavní) • Genetika hub
 - **Plodnice hub** (sporokarpy, askokarpy, bazidiokarpy, anatomie plodnic, **hymenofor**, hymeniální elementy) • Spory hub (typy a stavba, šíření a klíčení)
 - Nomenklatura hub • Sběr, určování a konzervace hub

Hymenofor (= struktura, již pokrývá hymenium) vytváří u různých hub různé tvary pro zvětšení výtrusorodého povrchu: Foto Martin Rozmoš, <http://botany.cz/cs/sarcodon-imbricatus/>

- hladký bez specifických tvarových struktur (výskyt u různých skupin i různých tvarů plodnic);
- ostnitý u rozlých (corticioidní houby) i stipitátních plodnic (lošáky);
- zprohýbaný, lamelovitý – původně hladký povrch vytváří lamelovitou strukturu, více či méně anastomózující (u rozlých, chorošotvarých i cantharelloidních plodnic);
- zvláštním typem jsou pseudolamely u *Schizophyllum*, podélně rozčísnuté a hygroskopické (za vlhka jsou rovné, za sucha se jejich půlky odchlípnou a stočí);



Sarcodon imbricatus

Foto O. Roučka,

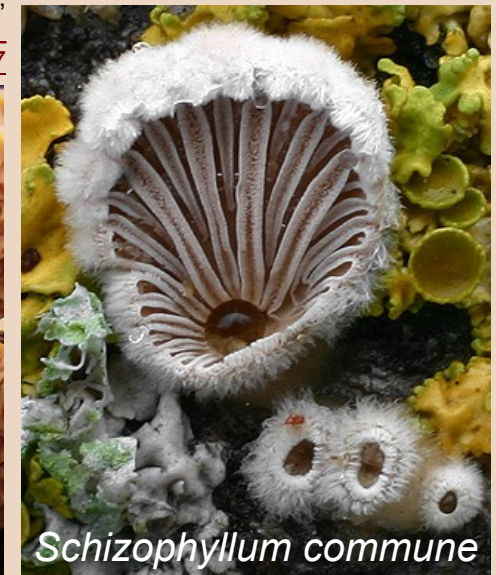
http://www.nahuby.sk/obrazok_detail.php?obrazok_id=53535; L. Tábi, http://www.nahuby.sk/obrazok_detail.php?obrazok_id=55827; B. Kuzmová, http://www.nahuby.sk/obrazok_detail.php?obrazok_id=55827



Stereum hirsutum

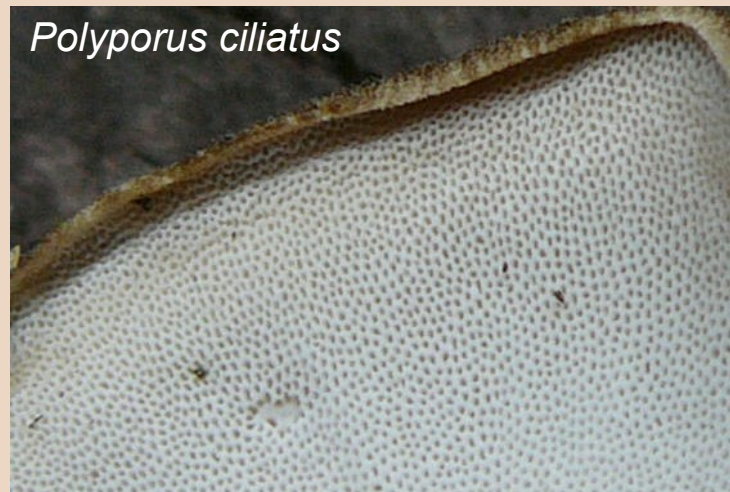


Merulius tremellosus



Schizophyllum commune

- pórovitý, rourkatý – póry v kompaktní hmotě (většina *Polyporales*), rourky se zřetelnými stěnami (většina *Boletales*);
- lupenitý je nejen nejčastější (většina *Agaricales*), ale i má nejvýhodnější poměr povrch /objem (zvětšuje výtrusorodý povrch až 20x);
- gastroidní představuje hymenium uzavřené v břichatkovitých plodnicích, pokrývající stěny dutin, komůrek nebo lamel v glebě (vizuálně podobné theciu zprohýbanému uvnitř tubero-thecií lanýžů).

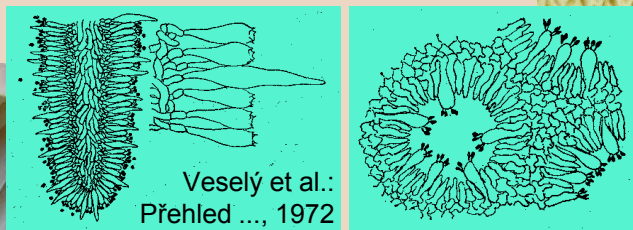


Polyporus ciliatus



Foto *Polyporus ciliatus*:
Věra Svobodová, <http://botany.cz/cs/polyporus-ciliatus/>

Foto *Xerocomus badius*:
<http://pms.wikipedia.org/wiki/Figura:Rourky.jpg>



Veselý et al.:
Přehled ..., 1972



Foto Jens H. Petersen, <http://192.38.46.48:8183/result.shtml?genSpec=Genus&ID=329>

Gomphidius glutinosus



Weraroa novae-zelandiae

<http://mushroomobserver.org/obs/7382?q=AUZr>

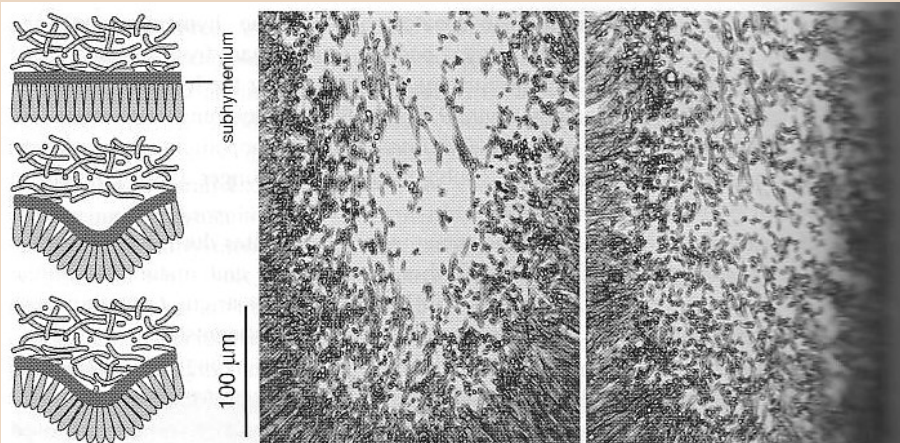


Figure 9.35: *Cantharellus* type initiation of the hymenophore, diagram of the early folding of the subhymenium and hymenium; and photographs of the hymenophore of *Cantharellus cibarius*. In the left photograph a young fold showing disrupted trama and cavities, in the right photograph the cavities in an older fold have been repaired by ingrown hyphae from the pileus context. – From Cléménçon 1997.

Cléménçon: *Cytology and Plectology ...*, 2004.

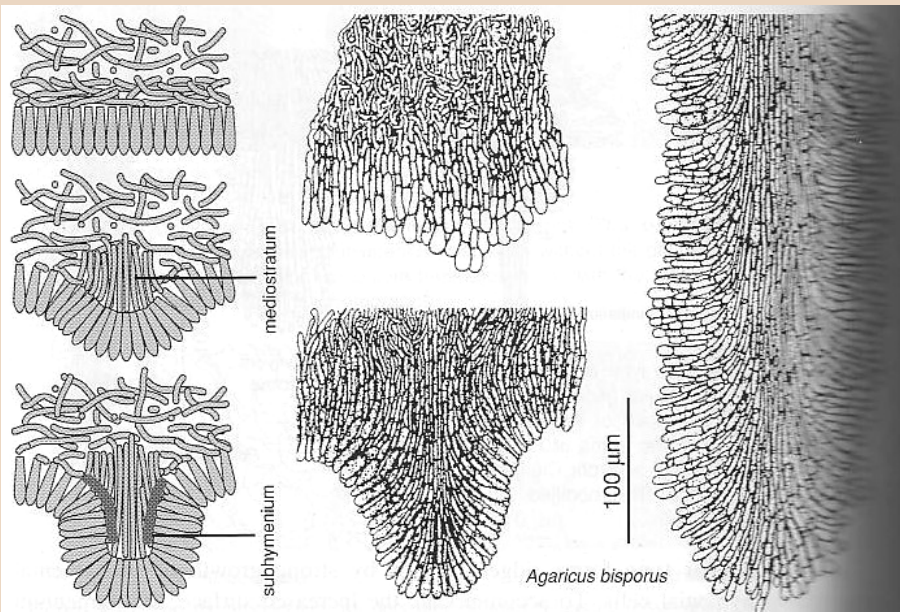


Figure 9.36: Primordial initiation of the *Agaricus* type hymenophore; diagram from Cléménçon 1997 and drawings of *Agaricus bisporus* from Hein 1930.

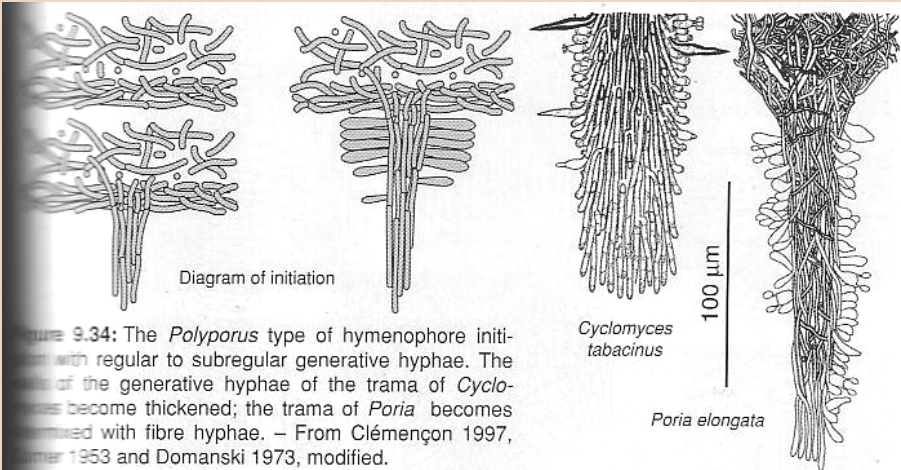


Figure 9.34: The *Polyporus* type of hymenophore initiation with regular to subregular generative hyphae. The hyphae of the generative hyphae of the trama of *Cyclomyces* become thickened; the trama of *Poria* becomes composed with fibre hyphae. – From Cléménçon 1997, after 1953 and Domanski 1973, modified.

Různé způsoby zakládání hymenoforu:
 narůstání přehrádek mezi póry, na jejichž stěnách se tvoří bazidie (choroše, nahoře);
 zvlnění hymenia tlakem narůstajících bazidií (liška, vlevo nahoře);
 růst lupenu jako samostatné struktury se stavbou tramy odlišnou od tramy klobouku (typ. pro *Agaricales*, vlevo dole);
 vznik mezer mezi lupeny lyzí původně kompaktního pletiva hymenoforu (muchomůrka, dole).

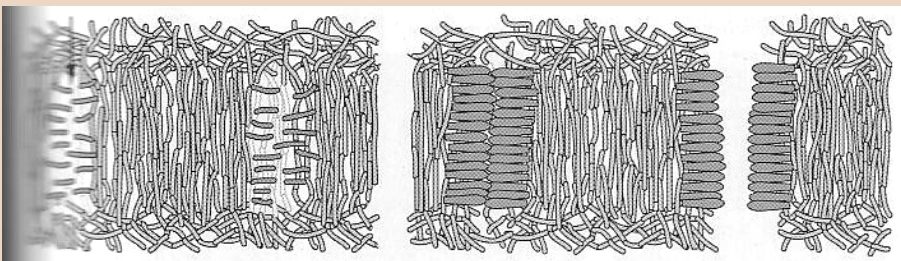


Figure 9.37: Diagram explaining the *Amanita* type hymenophore initiation by the formation of adjacent palisades. The spaces between the future gills contain degenerating hyphae (arrow) that disappear. The acrophysalides are still lacking. – From Cléménçon 1997, modified.

Pletivo hymenoforu lze směrem k povrchu rozlišit na jednotlivé vrstvy: trama-subhymenium-hymenium.

Trama lupenů: obvykle jsou rozlišovány 4 základní typy podle uspořádání buněk: regulární, irregulární, bilaterální, inverzní (obr. dole), případně je možno rozlišovat více dílčích typů (schéma vpravo).

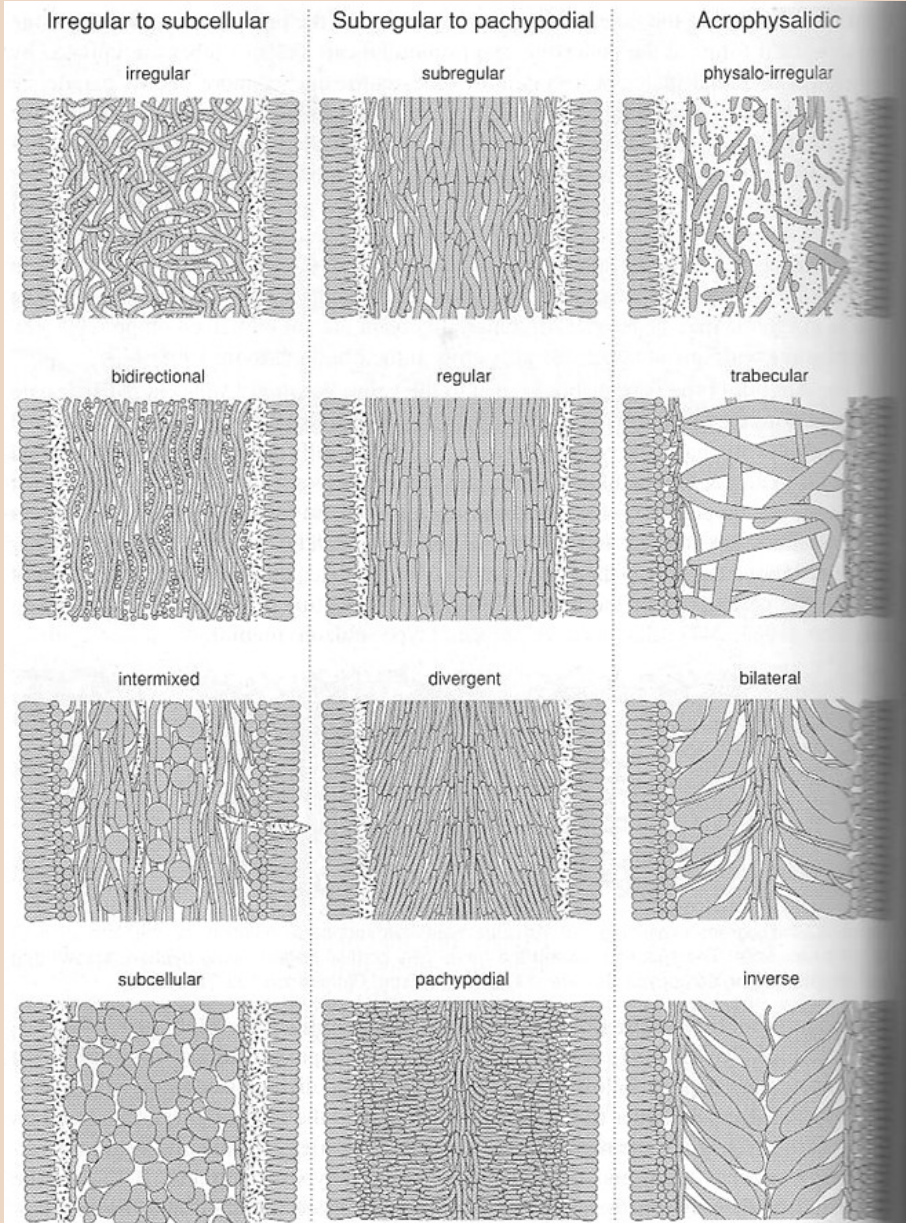
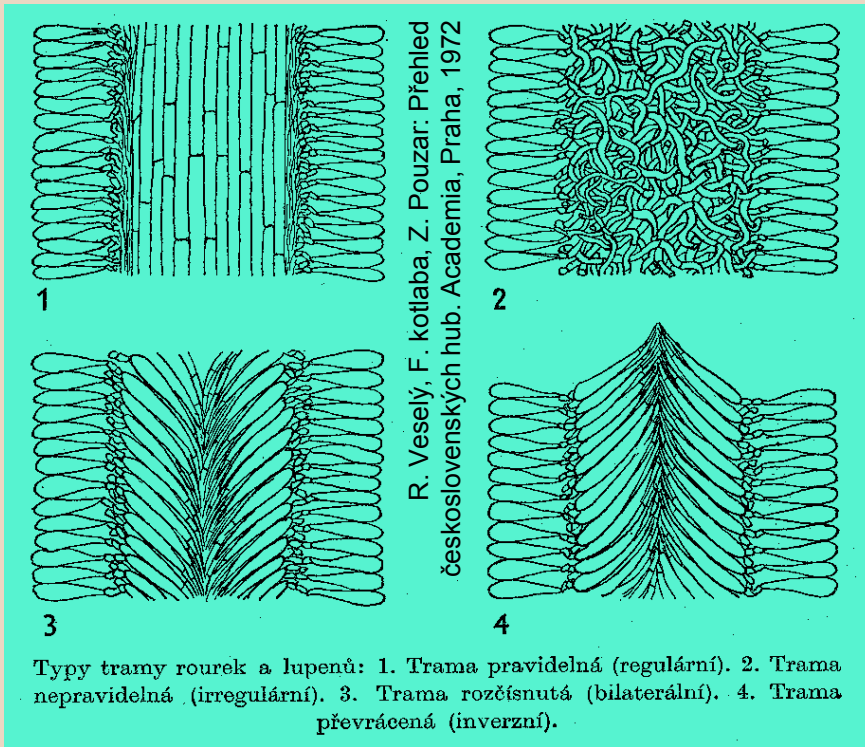


Figure 9.38: A selection of architectures of the hymenophoral trama of gill fungi, viewed in perian sections. The three groups are arbitrary and do not correspond to the traditional types. The irregular, bidirectional, intermixed, subcellular, physalo-irregular, trabecular and pachypodial tramas are lumped together in a single type called irregular. The pachypodial trama is a narrow, irregular subregular mediostratum with a very wide, horizontally divergent subhymenium, but it may also be seen as a very strongly divergent trama. The subcellular trama is sometimes irregularly pseudoparenchymatous. – Based on Cléménçon 1997, strongly modified.

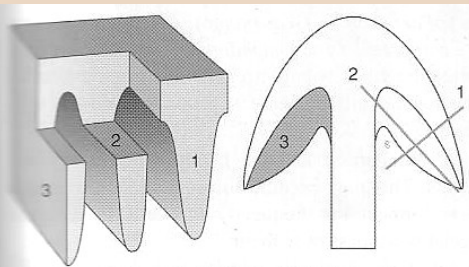


Figure 9.39: Terminology of the cutting planes for gills. 1: perradial. 2: paracial. 3: parahymenial. The angle between 1 and 2 is not necessarily orthogonal.

- trama **regulární** (= parallel; *Lepiota*, *Tricholoma* aj., řada lupenatých) – hyfy v mediostratu (střední oblast lupenu) jdou souběžně od báze k ostří lupenu; trama s ne zcela rovně jdoucími hyfami bývá odlišována jako subregulární;

Cléménçon: Cytology and Plectology of the Hymenomycetes, 2004.

- odvozené typy: divergentní trama – hyfy se stáčejí šikmo k povrchu lupenu; pachypodiální trama – hyfy se stáčejí kolmo k povrchu lupenu;

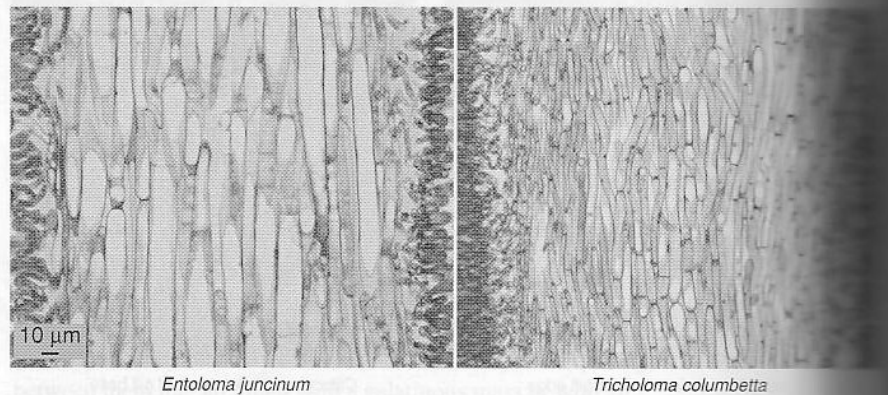


Figure 9.45: Regular gill trama with strongly inflated physalohyphae (*Entoloma*) and subregular trama with moderately inflated physalohyphae. Perradial sections. – Original photographs.

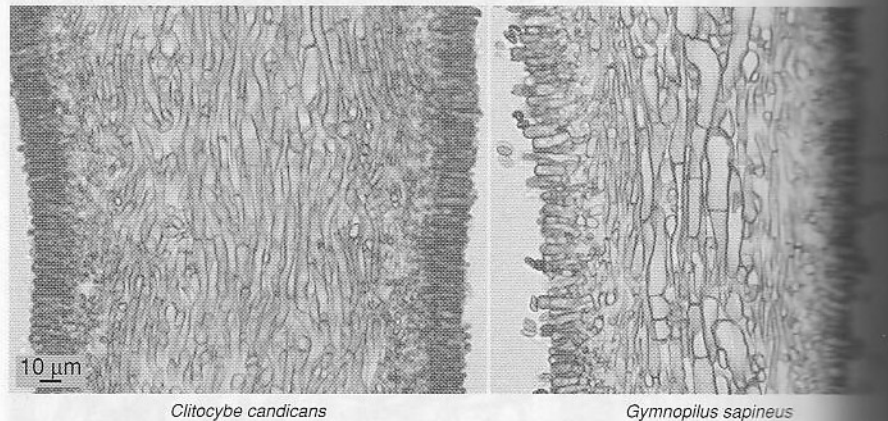


Figure 9.46: Subregular gill trama with moderately inflated and greatly inflated physalohyphae in perradial sections. In *Gymnopilus sapineus* a central mediostratum made from strongly inflated physalohyphae and a lateral stratum made from thin generative just beneath the subhymenium can be distinguished. – Original photographs.

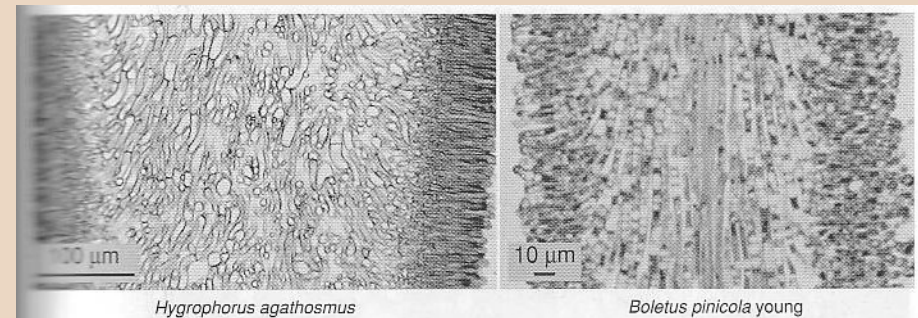


Figure 9.47: Divergent hymenophore trama. – Original photographs.

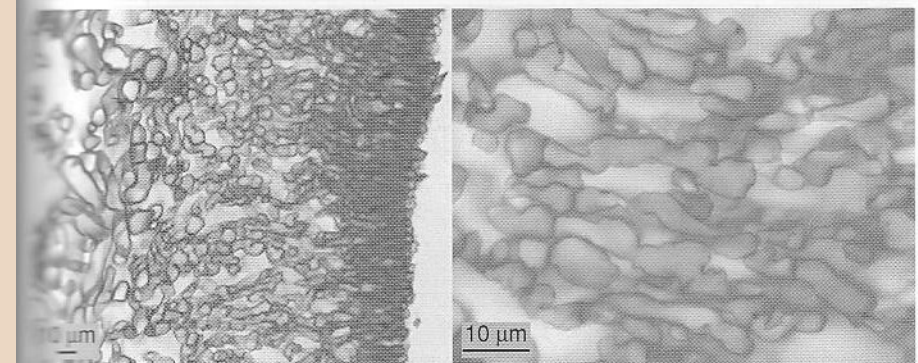


Figure 9.48: Pachypodial gill trama of *Chrysomphalina chrysophylla* in perradial sections. The left photograph shows the irregular mediostratum, the subhymenium and the hymenium, the right photograph shows the subhymenium only. – Original photographs.

- trama **irregulární** (= interwoven; *Pleurotus*, *Hygrophorus*) – hyfy tvoří v mediostratu nepravidelný propleteneč; – odvozené typy: bidirekcionální trama – hyfy tvoří "sít" ve dvou kolmých směrech podél lupenu a shora dolů; "promíchaná" (intermixed) trama – více typů hyf, jsou vmíchaný hyfy skeletové anebo trombo-plerní anebo ztlustlé buňky; subcelulární trama – stavba pseudoparenchymatická, krátké zakulacené buňky, prostory mezi nimi vyplňuje sliz nebo vzduch;

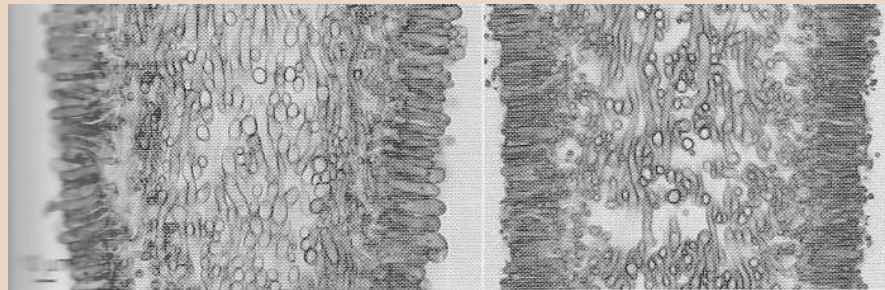
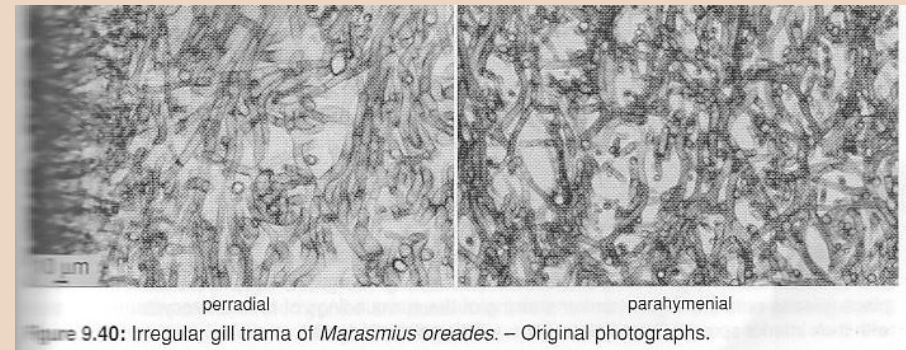


Figure 9.43: Bidirectional trama near the gill edge and in the gill base of otherwise subregular tramas. Perradial sections. – Original photographs.

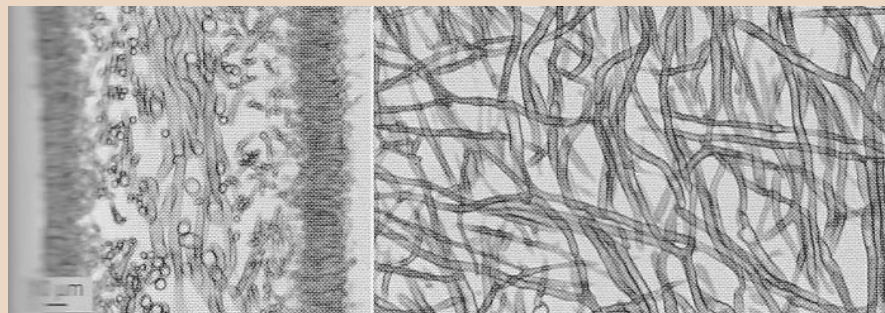


Figure 9.44: Bidirectional gill trama of *Panellus mitis* in paracial and parahymenial sections. The average directions of the hyphae are parallel to and at a right angle with the gill edge, in a paracial section and parallel to the hymenium. – Original photographs.

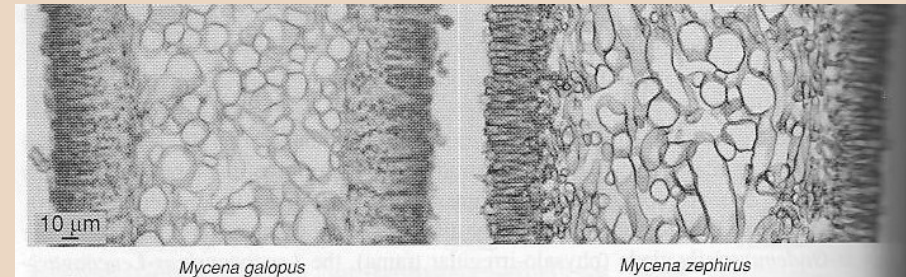


Figure 9.41: Subcellular or cellular gill trama arises from an irregular or a subregular trama by strong inflation of the hyphal cells. Near the subhymenium a few hyphae have conserved their original diameter. Perradial sections. – Original photographs.

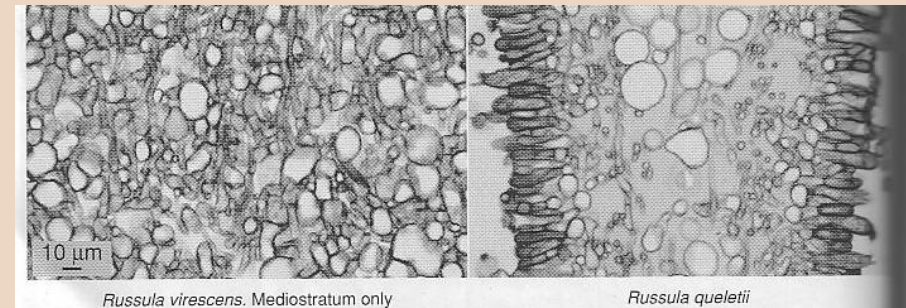


Figure 9.42: The intermixed gill trama of *Russula* species consists of the original generative hyphae and spherocysts. The gill trama of *Russula queletii* is gelatinous to keep the cells and hyphae in place (please note the slightly darker staining of the surroundings of the spherocysts, as compared with their interior space). Perradial sections. – Original photographs.

– odvozené typy s rozvolněnými hyfami: fysalo-irregulární trama – inflátní fysalohyfy jsou všesměrně rozptýlené v gelatinózní hmotě; trabekulární trama – mohutné inflátní hyfy roztahují vnitřní tramu lupenu a vytlačují zbylé hyfy k okraji;

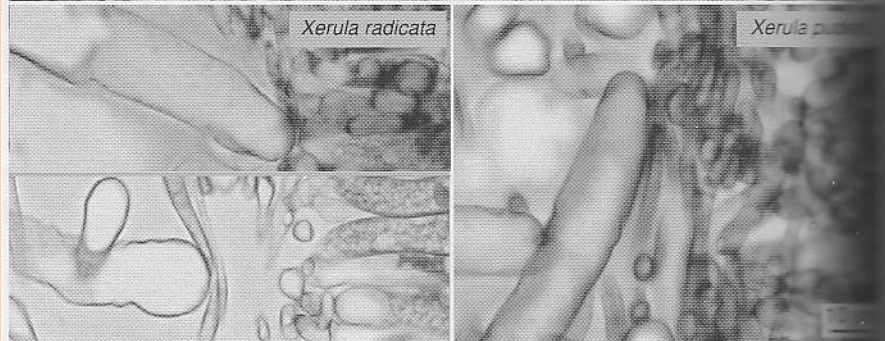
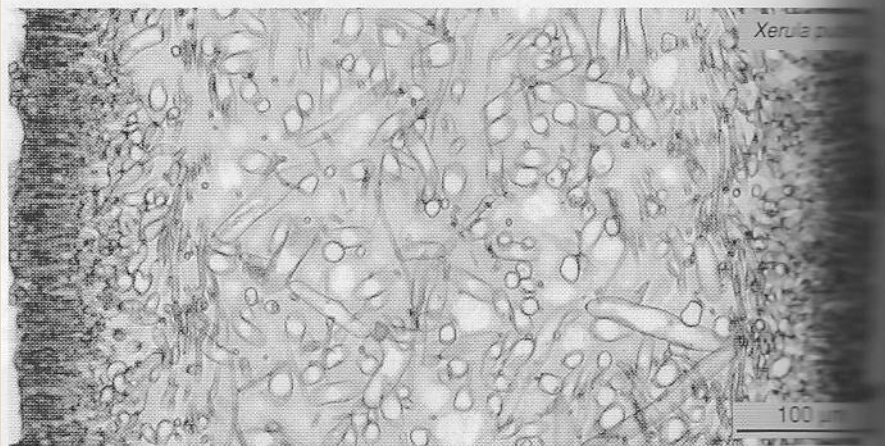


Figure 9.49: The acrophysalidic physalo-irregular gill trama of *Xerula pudens* (*Oudemansiella badia*) and *Xerula radicata* is gelatinous, shows some remaining generative hyphae between strongly inflated hyphae and acrophysalides. The details show acrophysalides pushing against the hymenopodium. – Original photographs.

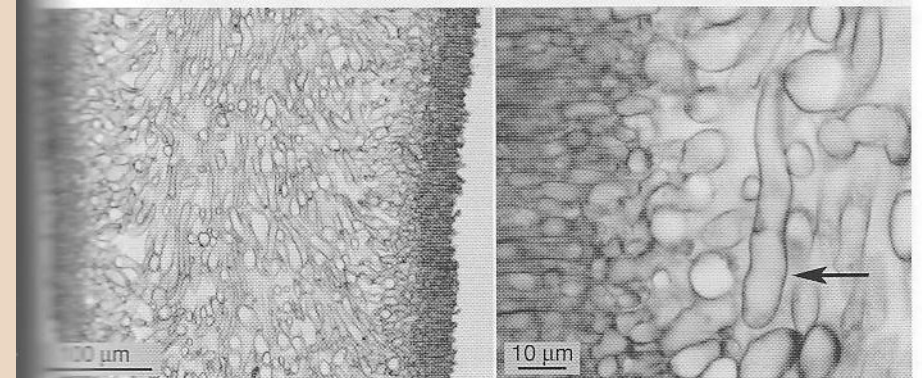


Figure 9.51: Primitive acrophysalidic gill trama of *Limacella glioderma* with rare acrophysalides (arrow). – Original photographs.

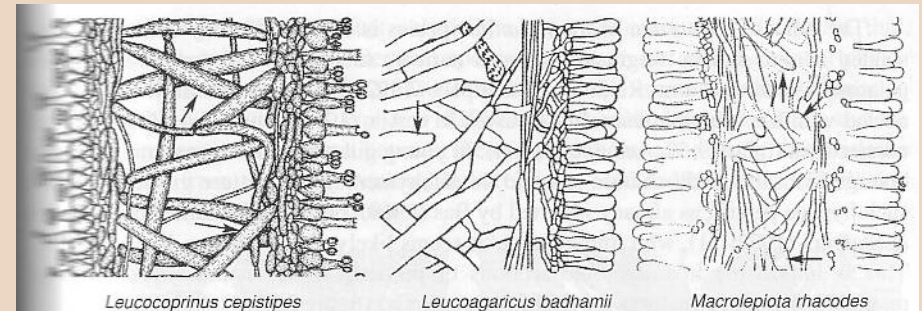


Figure 9.50: Trabecular gill tramas in the Leucocoprineae. Some acrophysalides marked by arrows. – In *Leucocoprinus cepistipes* the more or less transversely oriented, strongly turgescient hyphae arise from the mediostratum that was originally regular. The lateral hyphae of the mediostratum are pushed aside and form the hymenopodium that later forms more trabeculae and acrophysalides towards the inside and a cellular subhymenium towards the outside (from Buller 1924). – The mature gill trama of *Leucoagaricus badhamii* shows trabeculae and acrophysalides, a hymenopodium and a subhymenium (from Locquin 1942). – The young gill trama of *Macrolepiota rhacodes* shows developing trabeculae and acrophysalides (from Heinemann 1989).

Heinz Cléménçon: Cytology and Plectology of the Hymenomycetes. Bibliotheca Mycologica, vol. 199. J. Cramer, Berlin-Stuttgart, 2004.

- trama **bilaterální** (běžně označovaná pojmem divergent; *Amanita*)
 - inflátní hyfy (fysalidy) vybíhající šikmo dolů odstředivě z tenkého mediostrata;

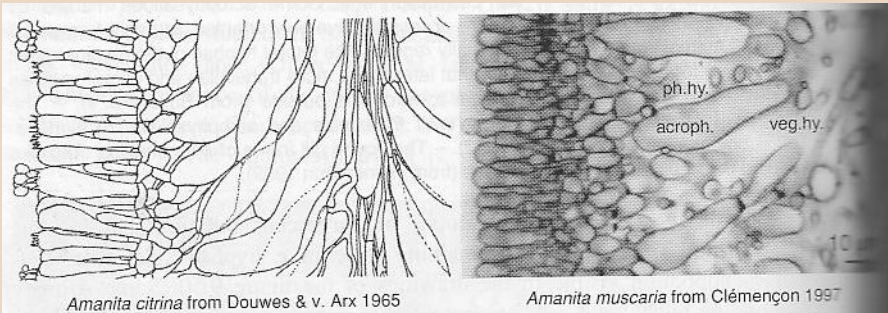


Figure 9.52: The bilateral gill trama of the *Amanita* species consists of a narrow, subregular stratum from which the turgescent acrophysalides diverge. The subhymenium is cellular. – *Amanita citrina*. Note that not all physalohyphae are free ending acrophysalides, but some continue as generative hyphae into the subhymenium. – In the young trama of *Amanita muscaria* some diverging generative hyphae (veg.hy.), some physalohyphae (ph.hy.) and acrophysalides (acroph.) can be seen clearly.

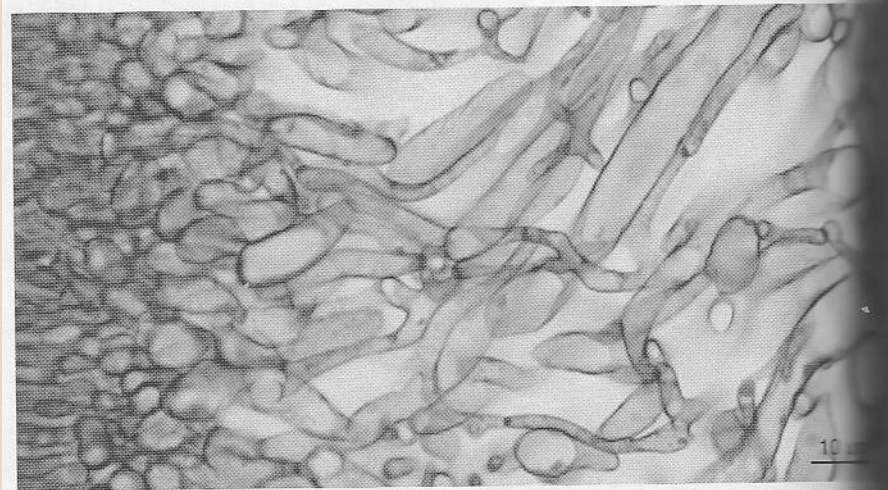


Figure 9.53: Occurrence of generative hyphae among the acrophysalides in the gill trama of *Amanita muscaria*. Thick, stained microtome section of material embedded in methacrylate keeps all structural elements in place. – Original photograph.

- trama **inverzní** (= convergent; *Pluteaceae*) – inflátní hyfy vyrůstají z tenkého hymenopodia šikmo dolů do středu lupenu.

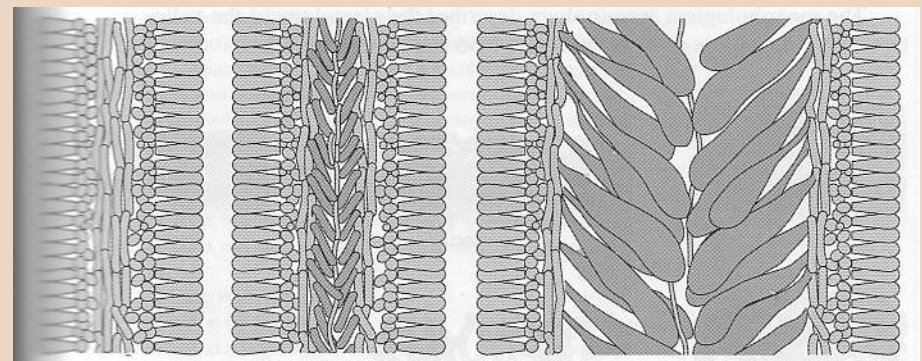


Figure 9.54: Diagram explaining the formation of the inverse gill trama and the hymenopodium from a subregular, subregular trama by formation of new cells and their turgescent expansion to become acrophysalides. The subhymenium is cellular. – From Cléménçon 1997, modified.

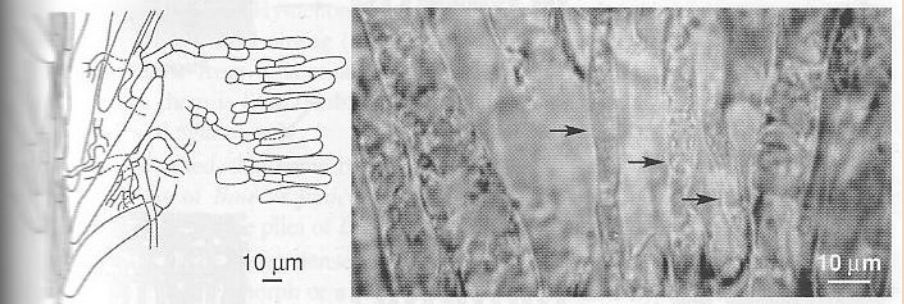


Figure 9.55: Origin of the acrophysalides and presence of generative hyphae (arrows) in the middle of the gill of *Pluteus*-species.

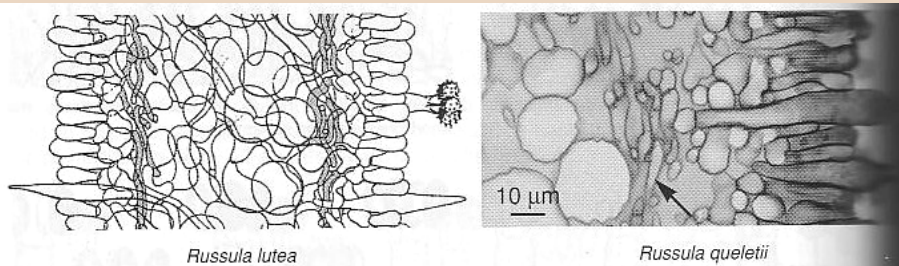


Figure 9.33: The hymenopodium as originally defined (*Russula lutea*, grayed), and as seen in a microtome section of *Russula queletii* (arrow). The cylindrical hyphae of the hymenopodium contrast strongly with the cellular subhymenium and the voluminous spherocysts of the gill trama. Drawing by Fayod 1889. Photograph is original.

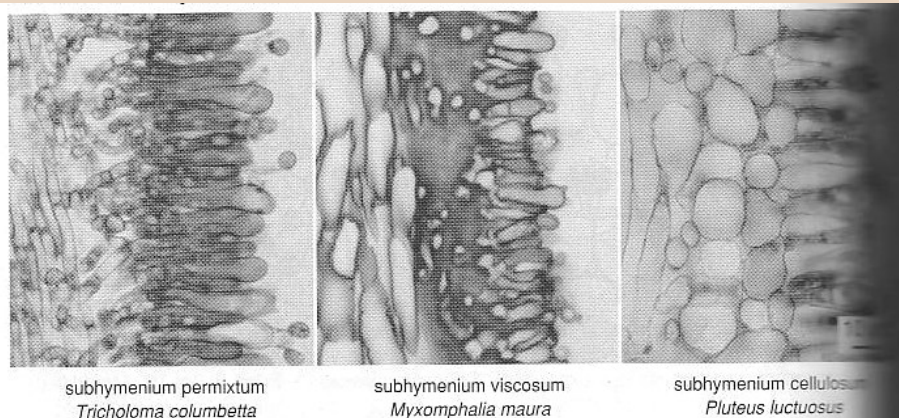


Figure 9.32: Architectures of the subhymenium in agarics. The subhymenium ramosum is not illustrated, but it resembles the subhymenium viscosum without the gelatinous matrix. – Micrographs stained with aluminium-zirconium haematoxylin or with the tannic acid iron reaction (subhymenium viscosum). – Original photographs.

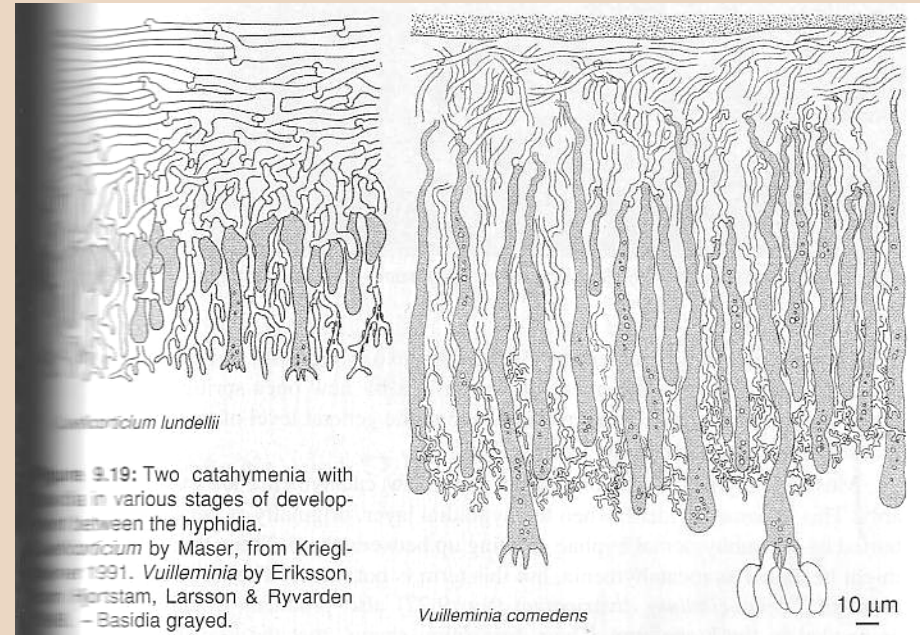
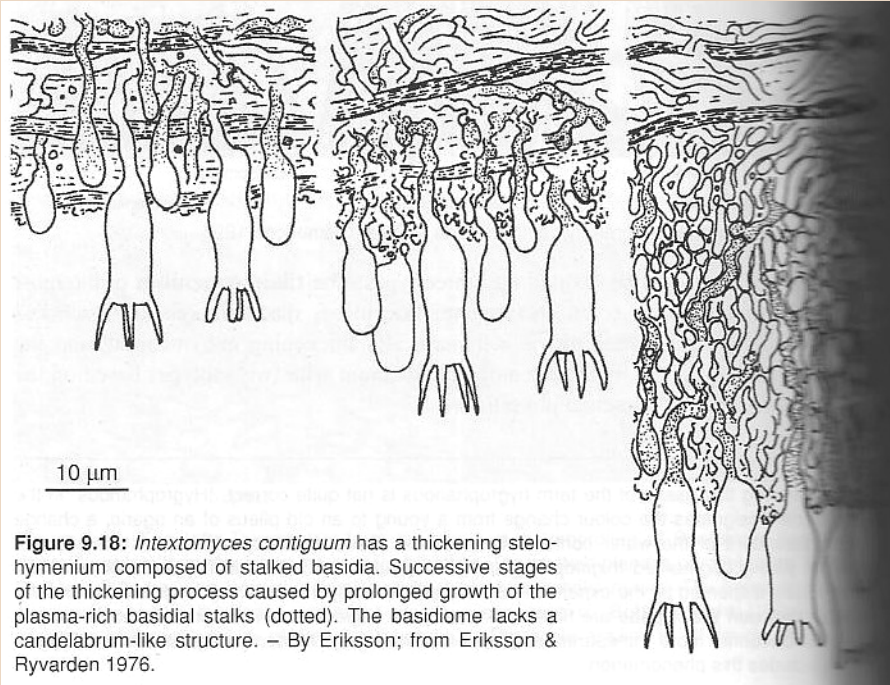
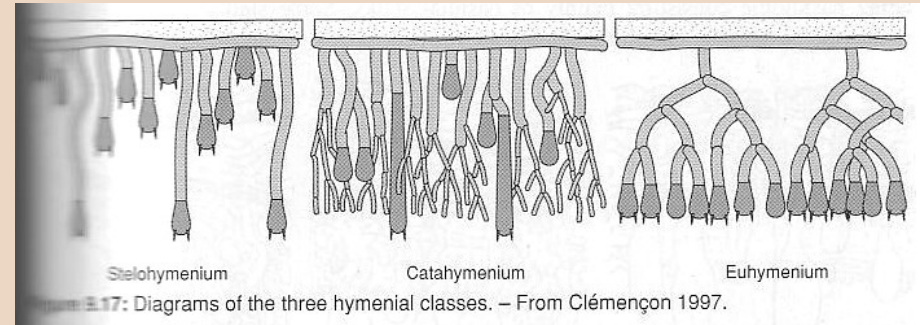
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Hymenopodium je úzká oblast tenkých generativních hyf mezi tramou a subhymeniem – zřejmě zbytek primordiální tramy lupenů, jejíž buňky (na rozdíl od buněk tramy) neztlustly; často není odlišováno od subhymenia.

Subhymenium je vrstvička buněk pod hymeniem, v níž vznikají hymeniové elementy – mohou je tvořit nepravidelně propletené hyfy (s. permixtum), buňky jdoucí rovnoběžně s povrchem, z nichž se kolmo odvětvují elementy hymenia (s. ramosum, příp. s. viscosum, jsou-li stěny buněk gelatinózní) nebo ztlustlé až kulovité buňky tvořící pseudoparenchymatickou strukturu (s. cellulosum).

Výtrusorodá vrstva na povrchu je rouško neboli **hymenium** – jsou rozlišovány tři typy hymenia podle uspořádání bazidií a příp. dalších hymeniálních elementů:

- stelohymenium – jednotlivé bazidie na koncích hyf prorůstajících kolmo k povrchu, bez dalších struktur;
- katahymenium – bazidie "utopené" ve vrstvě hyfidií (viz dále), mezi nimiž prorůstají ven;



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- euhymenium – bazidie se tvoří na větvených hyfách vyrůstajících ze subhymenia,
- tilaiohymenium – na "větvičkách" hyf svazky bazidií netvořící souvislou vrstvu;
- leptohymenium – svazky bazidií na "větvičkách" hyf tvoří souvislou vrstvu, nově tvořené bazidie vrůstají mezi stávající;
- auxohymenium – vrstvu "vyprázdňených" bazidií přerůstají nově tvořené (případ "tloušťnutí hymenia" hub, jejichž hymenium bývá vystaveno ničujícímu působení deště).

Cléménçon: Cytology and Plectology of the Hymenomycetes, 2004.

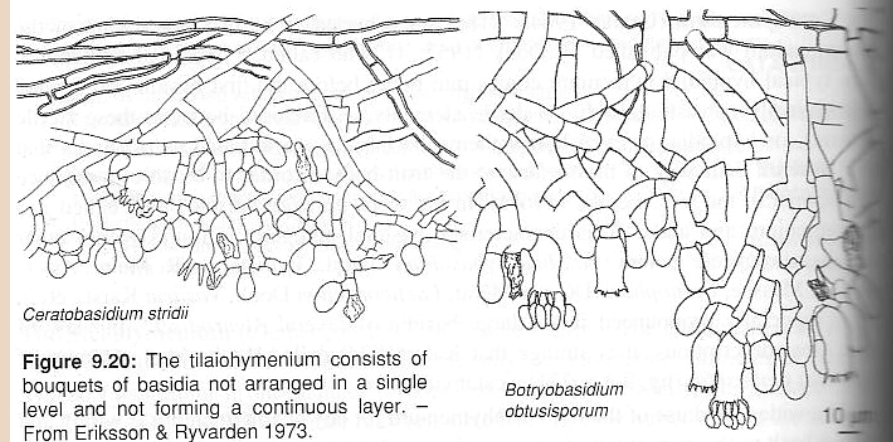
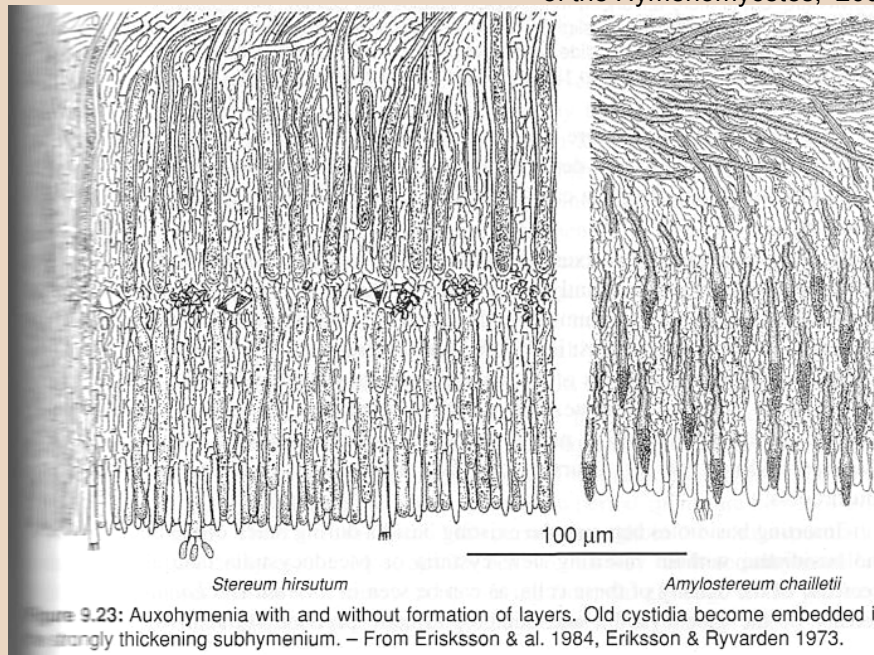


Figure 9.20: The tilaiohymenium consists of bouquets of basidia not arranged in a single level and not forming a continuous layer. – From Eriksson & Ryvarden 1973.

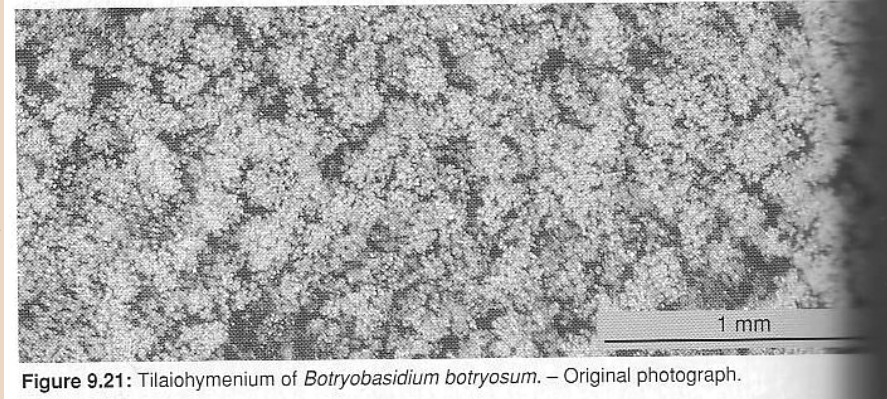


Figure 9.21: Tilaiohymenium of *Botryobasidium botryosum*. – Original photograph.

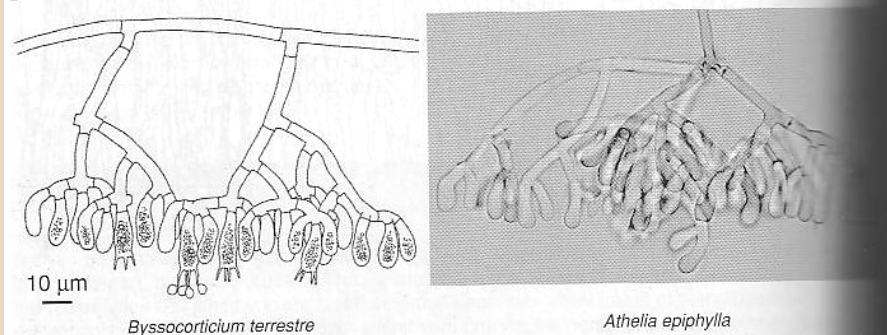


Figure 9.24: The basic structure of the leptohymenium is the candelabrum supporting many basidia arranged in a single, continuous layer and the placement of the young basidia between rather than above the older ones. In primitive corticiaceous fungi this layer may still be somewhat irregular, as shown here, but in more advanced fungi, e.g. in agarics and boletes, the leptohymenium is regular. The candelabrum of *Athelia* is slightly deformed, a consequence of the squashing of a three-dimensional structure between slide and cover glass. – Scale bar valid for both illustrations. Drawing from Eriksson & Ryvarden 1973, simplified. Photograph is original.

Dle postupu dozrávání bazidií lze rozlišit typ inekvihymeniferní (bazidie dozrávají postupně v úzké zóně postupující od ostří k bázi lupenu; některé hnojníky) a ekvihymeniferní (současné dozrávání bazidií na celé ploše hymenia, běžné). V izotropickém hymeniu dozrávají všechny bazidie zhruba zaráz, zatímco v anizotropickém se tvoří nepravidelná mozaika z oblastí "zralých" a "nezralých" bazidií (tyto typy jsou vždy ekvihymenif.).

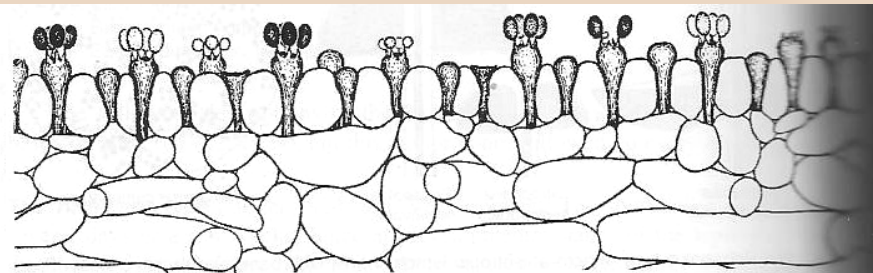


Figure 9.28: Isotropic hymenium of the *Bolbitius* type with monomorphic basidia between hymenial physalides. *Bolbitius vitellinus*. **Top:** Semi-diagrammatic section of the hymenium and the hymenium. Basidia in all stages of development, including collapsed ones, are represented between the physalides.

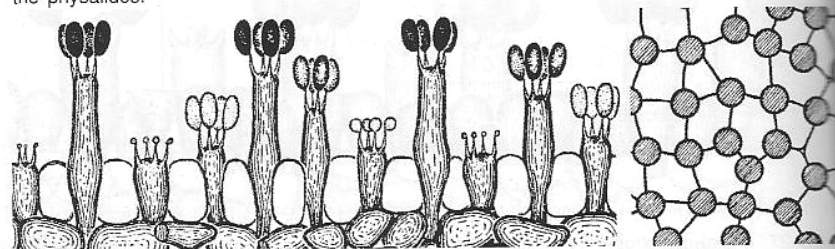


Figure 9.29: Isotropic hymenium of the *Leucocoprinus* type with tetramorphic basidia and hymenial physalides. Semi-diagrammatic section and surface view (basidia gray, physalides white). *Coprinus disseminatus*. – From Buller 1924, modified.

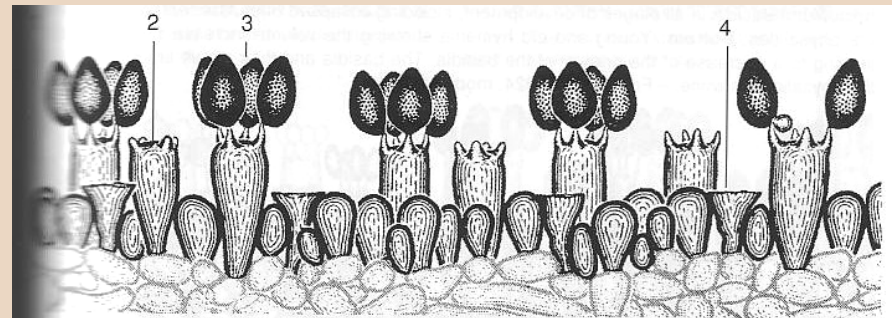


Figure 9.27: Macro-anisotropic hymenium of *Panaeolus campanulatus*, cross section through a large maturation area with four successive generation of basidia. 1 = basidioles; 2 = maturing basidia; 3 = mature basidia; 4 = collapsed basidia. The basidia of each generation are all in the same phase of development. – From Buller 1922.

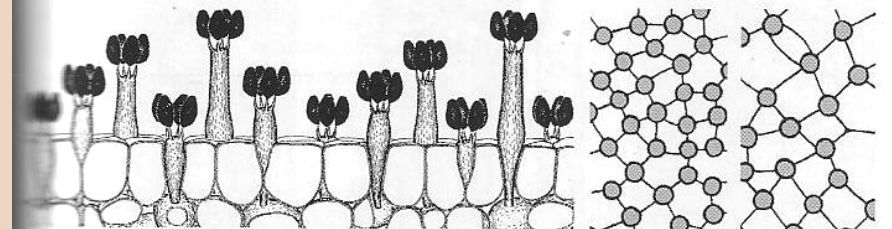


Figure 9.30: Isotropic hymenium of the *Coprinus* type with tetramorphic basidia and hymenial physalides. Semi-diagrammatic section and surface views of a young (left, physalides small) and a mature hymenium (right, physalides expanded). *Coprinus micaceus*. – From Buller 1924, modified.

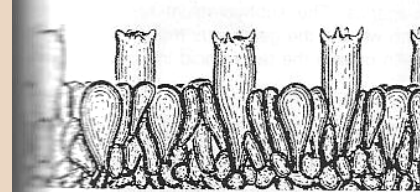
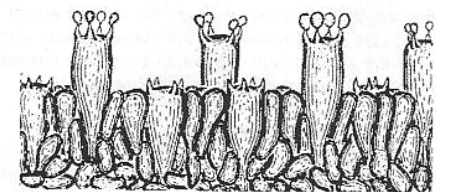
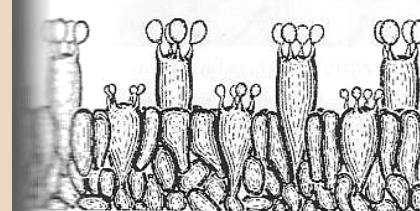


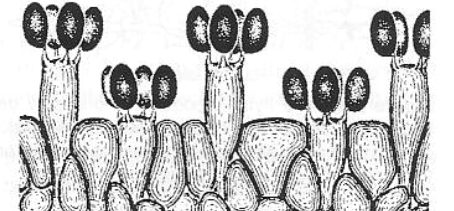
Figure 9.31: The long basidia have developed sterigmata, the short ones have not.



1 a.m.: The long basidia are developing spores, the short ones develop sterigmata.



2 a.m.: The long basidia have larger spores than the short ones.



Midnight: Both generations have fully mature spores ready for discharge.

Figure 9.31: The long and the short basidia of *Coprinus sterquilinus* belong to two different generations that mature with only a slight delay in the second generation. – From Buller 1924.