MORPHOLOGY AND TERMINOLOGY

For providing an accurate description and correct identification of a taxon, it is very essential to use certain terms for designating the various structures encountered therein. Excellent account of these has been given by Bondartsev (1953), Overholts (1953), Lentz (1954), Talbot (1954), Singer (1962), Donk (1964), Cunningham (1965), Thind (1975) and Ryvarden (1976). For various terms the author has followed Ainsworth et al. (1971) and Snell and Dick (1971). Consequently, important terms employed to describe morphological and microscopic features have been discussed below.

1. Fructification

This is the mature part of the fungus, which is easily noticed and usually gathered by the collector. It has been given various names by morphologists such as "Sporophore", "Fruite-body", "Fructification", "Carpophore", "Hymenophore", "Basidiocarp" and "Basidioma". I shall use the term "Fructification" for the fruit-bodies of polyporoid fungi.

Fructifications of polyporoid fungi have most diverse shapes. It may be resupinate, effused-reflexed, or pileate. The resupinate fructifications are the simplest forms which appear as crust extended on the substratum and facing outwards. Resupinate fructifications are common in species of Antrodia, Dichomitus, Junghuhnla, Oxyporus, Perenniporia, Poria s.l., Schizophora and some species of Inonotus, Phellinus and
Rigidoporus etc. Resupinate fructifications are composed of a context with intertwined hyphae, lying flat on the substratum without forming any pileate basidiocarp, and are typically produced on the under surface of logs, branches and fallen trees and producing on the free surface a layer of tubes. Occasionally the resupinate fructifications may be found on the vertical surface of the trunks where the unevenness of the surface facilitates the formation of tubes opening downward. Quite often some polypores which normally are pileate assume resupinate form when growing in situations unfavourable for the development of pileate form of the fructification. Effused-reflexed fructifications are attached for some distance by the back surface, the other portion extending out like shelf (rudimentary pileus). The effused-reflexed fructifications are common in Antrodia, Oxyporus and Tyromyces.

The pileate fructifications may be stipitate or sessile. The stipitate fructifications may be centrally stipitate, eccentrically stipitate or laterally stipitate. Stipitate fructifications are present in Goltricia, Microporus, Polyporus, some species of Amauroderma, Ganoderma, Onnia, etc. Sessile fructifications are attached at one side and are present in most of the polyporoid genera. Occasionally the stipe is poorly developed and the fructification is said to be substipitate. The fructifications may be annual, biennial or perennial. The perennial
fructifications are easily recognized by their pulvinate to ungulate shape and woody consistency.

2. Pileus

It is the structure of nonresupinate Hymenomycetes in which the hymenophore is always unilateral and is borne on the under (ventral) surface of the fruit-body. It may be applanate, ungulate, conchate, spatulate, pulvinate, dimidiate, fabelliform or infundibuliform.

The upper surface of the pileus may be glabrous, polished or covered with hairs which may be tomentose, velutinate, hirsute, strigose, scrupose or villose. It may be concentrically zonate or azonate, or sometimes radially striate (as in Polyporus grammonephalus, Gloeophyllum striatum), smooth, uneven or nodulose. Its colour varies from white to creamish to sulphur yellow, brown to dark brown to laccate-brown or brownish black to almost black or maroon to scarlet red. Occasionally the upper surface is covered with a thick and hard crust (Fomes fomentarius, Ganoderma applanatum etc.) or with a thin cuticle (Auricularia indica). It may be soft, fleshy, succulent, tough-fleshy, coriaceous, corky to woody.

3. Margin

In resupinate polypores, the margin may be thinning or abrupt or rhizomorphic (Perenniporia fulviseda) and is usually concolorous or lighter concolorous with the pore
surface. In pileate fructifications the margin may be acute, obtuse or blunt, entire or wavy straight or reflexed on drying, concolorous or different coloured. It may be sterile or fertile on the under surface.

4. Pore surface

It is the lower surface of the fruit-body, mature enough to have a tube layer. The pore surface may be smooth and even or uneven and irregular, shining or dull, concolorous with upper surface or differently coloured. The pores may be regular or irregular, small to large, circular to angular, hexagonal, daedaloid or labyrinthiform, round to radially or concentrically elongated.

The hymenophore is always unilateral and is borne on the under surface (Positively geotropic) of the fructification or on the free surface of resupinate fructifications. It is usually the hymenophore that determines the configuration of the hymenium proper. It may be poroid, lamellar or irpicoid depending upon the hymenium spread over dissepiments of tubes, gills or teeth, respectively. In Lenzites it may be poroid at the base, become Labyrinthine and finally distinctly lamellate close to the margin. The size of the pores is given as the number per mm.

5. Hyphal system

A foundation to a better understanding of polypores was laid by Corner (1932a,b,c) when he published his very critical, now classical, studies on the hyphal construction.
of some species of polypores (*Fomes, Polystictus*). Corner (1932a) described five kinds of hyphae present in the fruit-body of *Polystictus xanthopus* Fr. and named them as 'Skeletal hyphae', 'Generative hyphae', 'Binding hyphae', 'Mediate hyphae' and 'Mycelial hyphae'. In his second paper, Corner (1932b) stressed the five systems of hyphae in the fruit-body of *Polystictus xanthopus*. Only the skeletal, binding and generative systems are characteristic; they are the result of division of labour in the common arrangement in which all the hyphae having the same structure and function belong to one system. The other two kinds of hyphae, 'Mycelial hyphae' and 'Mediate hyphae', were not considered as significant by Corner because the 'Mycelial hyphae' (mycelium connecting the basidioecarp with food-supply in the substratum) are present in all the species, and the 'Mediate hyphae' vary in extent as the transition from generative to skeletal or binding hyphae is gradual or abrupt. These mediate hyphae, being a developmental phase are a go between the generative and skeletal or generative and binding hyphae. He (1932b) further added "It is convenient for comparison to say that such a fruit-body (*P. xanthopus*) is composed of three systems of hyphae or that it is trimitic".

The Corner's concept of hyphal system is fundamental to all modern concepts. The polypores comprise morphologically distinct hyphae, which are principally of three types.

(A) Generative hyphae
(B) Skeletal hyphae
(C) Binding hyphae
According to how many types of hyphae are present a species is said to be:

I. Monomitic - if only generative hyphae are present.
II. Dimitic - if generative hyphae and skeletal or binding hyphae are present.
III. Trimitic - if generative hyphae, skeletal hyphae and finding hyphae are present.

A. Generative hyphae

The generative hyphae are the main hyphae which ultimately give rise to the basidia, and to all other structures. They are usually thin-walled, branched, septate, clamped or without clamps, and with abundant protoplastic contents. It dried specimens, the thin-walled hyphae soon collapse and may be difficult to find.

B. Skeletal hyphae

The skeletal hyphae are thick-walled and correspondingly with narrow lumen, unbranched or rarely branched, aseptate or occasionally pseudo-septate, straight or slightly flexuous with lumen more or less obliterated in mature parts.

C. Binding hyphae

The binding hyphae are thick-walled, to almost solid with narrow lumen, much branched and aseptate.

All modern workers now recognize the importance of hyphal construction in the systematic study of Polyporaceae (Corner, 1953; Lowe, 1957, 1966; Teixeira, 1962; Donk, 1964; Domanski, 1965; Domanski et al., 1967; Talbot, 1971;
6. Context

The context is the sterile part between the tubes and the pileus surface. It may be extremely thin and scarcely differentiated, or stout and several centimeters thick. It may be homogeneous or duplex, azonate or zonate, soft or hard, fleshy, succulent and xanthochroic (colour changes to dark brown with KOH) or non-xanthochroic (no colour change with KOH). If there is a distinct cuticle below a tomentum or other type of cover, the context is defined as the structure below the cuticle. The colour of context varies from white to creamish, yellowish brown, brown, dark brown, pink to rose or red. It is composed of hyphae either intertwined or radiately arranged and parallel.

7. Hymenium

Generally the hymenium is formed of a dense palisade layer of basidia and basidioles but sometimes certain sterile structures such as cystidia, cystidioles, or setae are also interspersed among them. The hymenium usually lines the interior walls of tubes, sometimes it is distributed over lamellae (Gloeophyllum, Lenzites, Cyclomyces, Cycloporus) or spines (Flavodon, Irpex). In merulioid members of the polypores the hymenium is continuous over ridges or folds whereas in others the pore-mouths or spines of dissepiments are sterile.
8. Basidia

The basidia in the Polyporaceae are of holobasidious type. They produce their sterigmata apically and typically are more or less clavate or club-shaped. The basidium is an all important seat of several vital functions in the life-cycle of the Basidiomycetes. These functions, in sequence, karyogamy, meiosis, spore production and spore discharge are performed by an all important single cell, the holobasidium.

9. Basidiospores

The basidiospores are of great diagnostic value up to generic and specific level. They show a wide range of variation of size (minute, allantoid basidiospores 3-4 x 0.4-0.5 μm of *Incrustoporia semipileata* to the ellipsoidal basidiospores, 14-24 x 5-8 μm of *Fomes fomentarius*), colour (hyaline to subhyaline, light brown to brown), ornamentation (smooth, or asperulate to echinulate, striate), and shape (truncata, ellipsoidal to globose, cylindrical or allantoid). The basidiospores are complex in *Bondarzewia montana* with amyloid ridges. In *Ganoderma*, *Amauroderma* the wall appears double with a smooth outer, hyaline perisporium and ornamented, inner brown exosporium. In *Pachykytospora* these are irregularly warty and warts unite to form longitudinally anastomosing striations. They may be amyloid, dextrinoid or non-amyloid, cyanophilous or acyanophilous.
Ancillary structures

These are special modified structures present in the hymenium or occasionally in context or trama. Generally they are of important diagnostic value for various genera and species. A brief outline of the various structures commonly present in Polyporaceae is given below.

(i) Cystidia

These are highly variable sterile structures usually present in the hymenium. They are hyaline or light coloured, never dark brown or black even in KOH. They are usually classified into two groups depending on their origin:

(a) Hymenium cystidia which originate in the hymenium and usually project beyond the basidial layer, into the pore cavity. They are more common in monomitic species and have a septum at the base. They may be thin to thick-walled, smooth to encrusted. (b) Tramal cystidia originate deep in the trama and may or may not enter the hymenium. They occur mostly in dimitic and trimitic species and are often thick-walled and encrusted at the apex e.g. Oxyporus, encrustation may extend over a long section of the cystidium e.g. Chaetoporus, Junghuhnia. The cystidia show a great range of variation in shape i.e. cylindrical, clavate, subulate or ventricose; thickness of wall i.e. thin-walled (leptocystidia) or thick-walled lamprocystidia.

Gloeocystidia are thin-walled with a granular or oily contents, larger than basidia and usually project above the
hymenium (Heteroporus, Tyromyces gloeocystidiatus). Some sterile elements produced by the hyphae of the trama retain their hyphal nature and do not become more or less characteristically inflated and are called 'hyphidia' or 'Metuloids'. Cystidioles are smooth, tapering sterile elements that present among basidia.

(ii) Setae

These are rigid, thick-walled, deep yellow or brown in colour and changes to dark brown to black with KOH. These are present in species of Inonotus, Onnia, Phellinus and some species of Coltricia. Setae are of two types, hymenial and trama. The apex may be straight or distinctly bent or hooked. They are either subulate or ventricose. In some species the form of the setae is fairly constant, in other species there may be a mixture of both subulate and ventricose setae. The trama setae run parallel to the tube wall or may project obliquely into the hymenium.

(iii) Setae hyphae

These are modified hyphae with thickened walls and appear as coloured spines in the tissues of context and trama, measuring 4–25 μm in diameter and may reach a length up to 400 μm. They are present in some species of Inonotus and Phellinus.
(ix) **Conducting hyphae**

They are modified generative hyphae with thin walls and greater diameter than the normal generatives and are scantily septate and filled with a fluid, white or orange, that exudes as drops when fresh specimens are broken or bruised. These hyphae stain deeply in aniline-blue and are present in all species of *Grifola* and some species of *Piptoporus*. 