

campestris is cultivated extensively under the trade name *A. bisporus*.

The plant body—The plant body consists of two parts viz : (a) *vegetative mycelium* which remains hidden within the substratum and (b) the *basidiocarp* i.e. sporophore which comes out of the substratum as a visible structure.

(a) *Vegetative mycelium*—It starts as primary mycelium from the germination of an uninucleate basidiospore. Primary mycelium is composed of filamentous, loosely tangled felt of colourless, short-celled, septate hyphae which ramify in the substratum just beneath the surface. Each septum of the cell is perforated by a minute pore which facilitates intercellular communication. Hyphal fusions (anastomosis) often occur when one branch meets another. After germination of the basidiospore the primary mycelium and all the hyphal cells constituted therefrom upto the sub-hymenial stage are multinucleate cells containing granular, vacuolated protoplasm with oil drops as reserve food. The mycelium of *A. campestris* and *A. bisporus* is perennial, and single mycelium may bear numerous fruiting bodies (basidiocarps) year after year. Sometimes it produces much compacted masses of hyphal strands known as *rhizomorphs* which bear sporophores. In some species of *Agaricus* the sub-terrestrial mycelium has a tendency to grow in all directions from a central point (i.e. centrifugal extension) and to form a large invisible colony ; at the time of sporulation, sporophores are formed at the tips of the hyphae and thus form a circular ring on the ground known as *fairy ring*¹.

According to Webster (1970), both wild (i.e. field) and cultivated mushrooms e.g. *A. campestris* and *A. bisporus* are *homothallic* "in that sense that a mycelium derived from a single spore is capable of fruiting. In both species there is nuclear fusion in the basidium followed by two nuclear divisions, presumably meiotic."

(b) *Structure of Basidiocarp*—Basidiocarp, i.e. sporophore or fruiting body is commonly known as "mushroom." The tissue of the basidiocarp in *Agaricus* is pseudoparenchymatous, composed of an aggregation of hyphae. The hyphae are usually thin-walled. During the formation of young sporophore (basidiocarp), it is reported that subhymenial cells are multinucleated ; only two nuclei migrate from the subhymenial cell to the hymenium i.e. to the young basidium. In *A. campestris* no clamp connection has been recorded at the base of the basidium. Basidiocarps start their development as tiny knots of hyphal cells formed at different points of interwoven mycelial strands. When the substratum is wet and other conditions are favourable, these knots of hyphal cells increase in size, emerge through the surface of the substratum and make their appearance in the form of small rounded bodies called *buttons*, and the corresponding stage is known as the *button stage*. These buttons enlarge in size and each one of them ultimately develops into a mature basidiocarp.

The mature basidiocarp i.e. sporophore consists of (a) *stipe*—it is a stalk-like structure and composed of two types of cells viz. wide inflated cells and narrow thread-like cells ; 5—8 cm long ; cylindrical and tapering at the base, white in colour ; there is a ring i.e. *annulus* towards the upper part of the stipe. The hyphae within the stipe is densely packed towards the

periphery forming an apparently parenchymatous cortex, in the centre the hyphae are loosely arranged to form the medulla; and (b) *pileus*—it is situated at the apex of the stipe. Pileus is usually the expanded portion which is originally convex at its dorsal part but becomes flat with maturity. Mature pileus is 5.0 to 12.5 cm in diameter. The upper surface (dorsal) is thin, dry, smooth and white or cream in colour—this part is also known as *flesh*. The ventral portion i.e. lower surface of the pileus is composed of many thin, radiating, free, pink (when young) or purplish-brown (when mature) *lamellae* i.e. *gills*.

In *A. campestris* the gills are of *aequi-hymeniferous*¹ (aequi-hymenial) type. Gills are wedge-shaped in longitudinal section. The term *aequi-hymeniferous* refers to the condition in which the hymenium develops in an equal manner all over the surface of the gill i.e. basial development is not localised at any particular area on the gill.

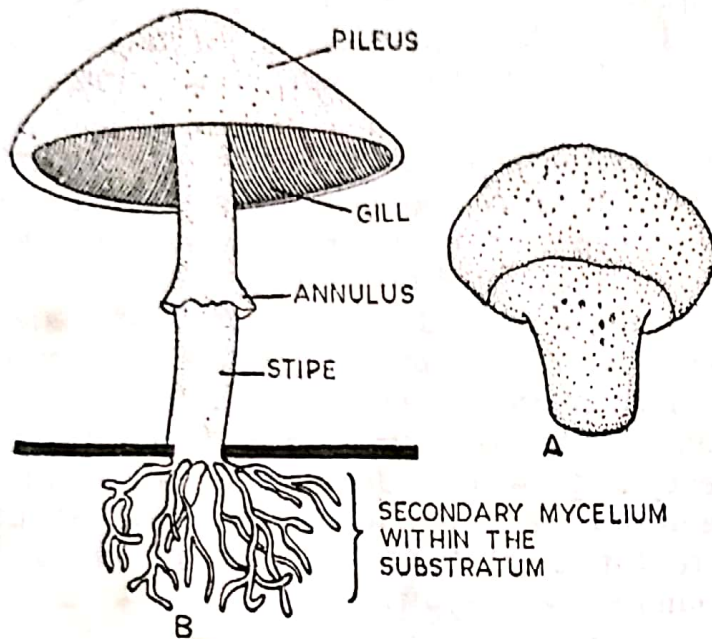


Fig. 4.15—*Agaricus campestris*. A—Structure of the young basidiocarp (button stage). B—Mature structure of the basidiocarp (partly diagrammatic).

the trama and is composed of short, more closely packed hyphae running obliquely towards the outer surface. Hyphae are composed of small multinucleate or binucleate cells.

(c) *Hymenium*—This is a zone which lies outside the subhymenium and consists of the terminal cells of the same hyphae constituting the subhymenium and trama. In this zone, hyphae have changed their original direction to such an extent that they now stand at right angles to the surface of the hymenium of gill. Hymenium contains palisade-like club-shaped cells rich in protoplasm, some of the cells of this region develop into stout *basidia* and the others into sterile and more slender structures called *paraphyses* (singular: *paraphysis*).

Each basidium acts like a spore mother cell. The young basidium is binucleate i.e. contains two nuclei. These two nuclei of the basidium fuse to form a diploid nucleus; this nuclear fusion i.e. karyogamy is soon followed by a meiotic division so that 4 haploid daughter nuclei are formed. From the apex of each basidium four slender projections, known as *sterigmata*, are produced; the tip of each sterigma swells up. At the same time, one nucleus comes to lie at the base of each sterigma which ultimately passes into the swollen tip to form a *basidiospore*. So from each basidium, 4 basidiospores are produced in *A. campestris*. *A. bisporus* is a 2-spored mushroom, here 2 basidiospores are formed from each basidium. In both the species there is

The structure of an *aequi-hymeniferous* gill of *A. campestris* in longitudinal section shows the following:

(a) A central tissue region composed of longitudinally running hyphae called the *trama*. Hyphae consist of elongated and compactly arranged multinucleate cells coming from the pileus.

(b) *Subhymenium*—this region lies on both the sides of

the trama and is composed of short, more closely packed hyphae running obliquely towards the outer surface. Hyphae are composed of small multinucleate or binucleate cells.

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nuclear fusion in the basidium followed by two nuclear divisions, probably meiotic. In *A. campestris* only one nucleus enters each basidiospore but in *A. bisporus* two nuclei enter—hence basidiospores in *A. campestris* are uninucleate while in *A. bisporus* they are binucleate. Each mature basidiospore is thick-walled, coloured (pink when young but purple-brown in mass when mature), 1-nucleate or 2-nucleate, more or less kidney-shaped and contain oil

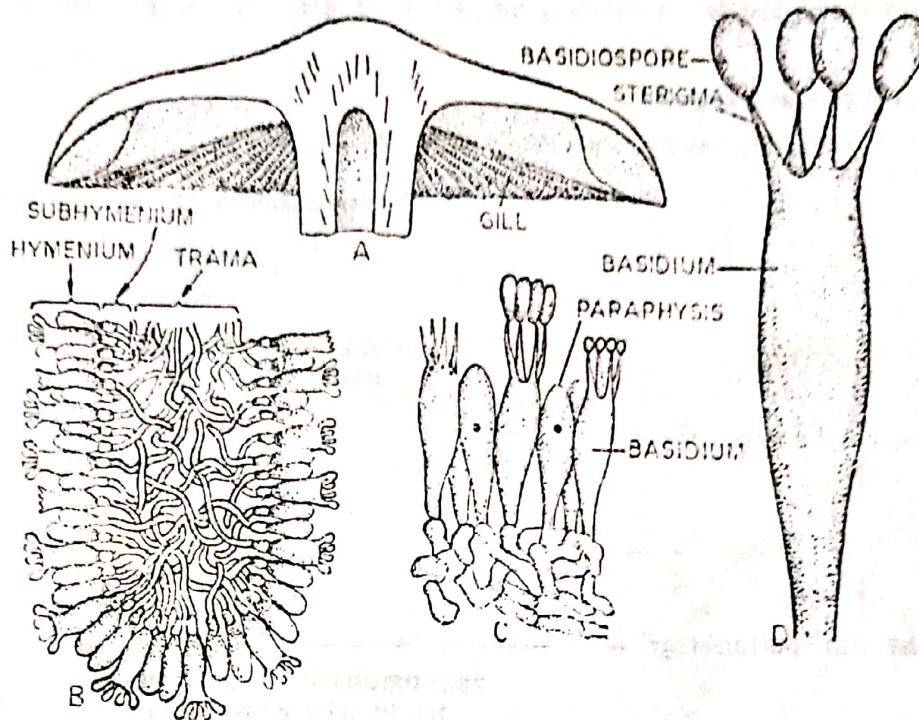


Fig. 4.16—*Agaricus campestris*. A—Gills in sectional view. B—Structural details of gills in longitudinal section. C—Part of hymenium. D—Single basidium with basidiospores (enlarged).

as food reserve. Each basidiospore has small projection or hilum at the end where it joins the sterigma. Before the spores are discharged, a small droplet of liquid appears at the hilum of each-spore; when these droplets of liquid attain full size, the spores are shot off from the sterigmata with violence. After spore discharge the basidia collapse. It has been observed that neither all the basidia mature at a time nor all the basidiospores are discharged at a time. Their discharge take place one after the other. The spores after falling on the ground germinate. At the time of germination several (1-3 generally) spherical or irregularly-shaped germ tubes are produced from any region of a spore. These germ tubes give rise to much branched new septate primary mycelia from which again new basidiocarps are formed by anastomosis of the mycelium.

Each basidiospore is therefore a potential starting point for a vegetative primary i.e. monokaryotic mycelium. Basidiospores are produced in large quantity. Buller (1909) has calculated that the detached cap of *A. campestris* produced 1.8×10^2 spores in two days, at an average rate of 40 million per hour—hence it is obvious that basidiospores are the important spore-forms in the *Agaricus*, only a few members of which produce asexual spores.

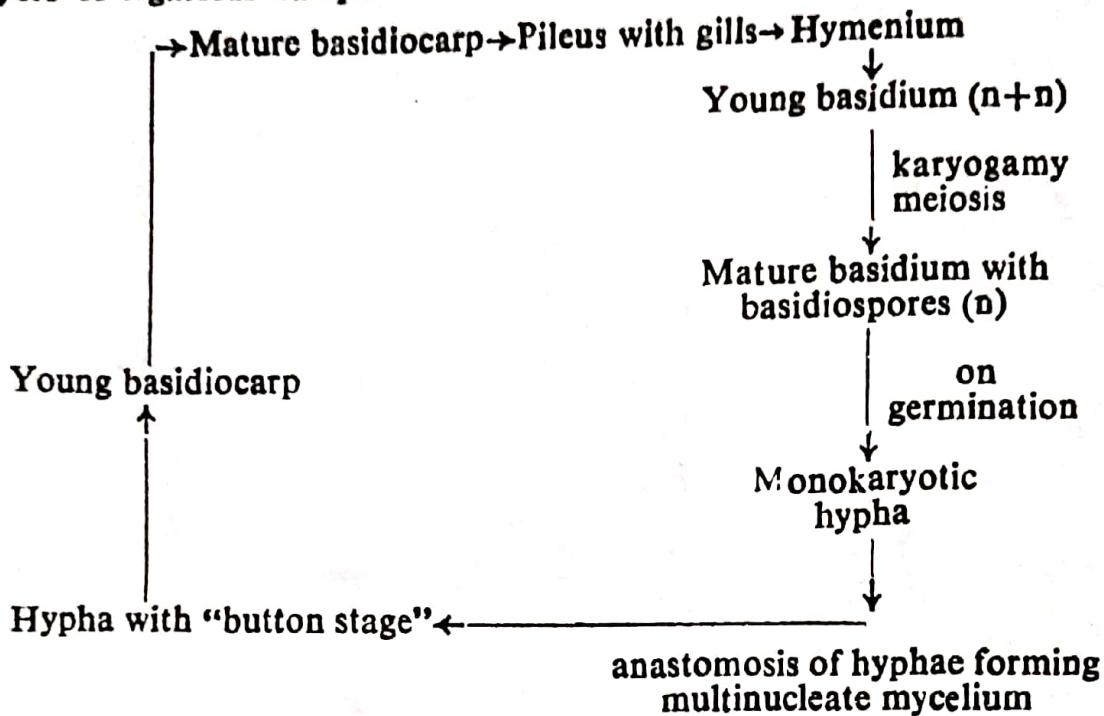
REPRODUCTION—*A. campestris* and *A. bisporus* reproduces asexually by chlamydospores. Sexual reproduction is effected by dikaryotization through somatogamy, which is ultimated by karyogamy and meiosis within basidia.

Economic Importance—Most of the members of Agaricales are edible. *A. bisporus* is the cultivated white mushroom which is specially cultivated for food in different States of India, Europe and N. America. *A. campestris* is

the field-mushroom ; as this species is recognised widely as field mushroom, so it in that sense is edible. The food value of *Agaricus bisporus* is equivalent to that of cabbage. *Agaricus bisporus* therefore, has some value for its protein, mineral and vitamin contents. Based on the cultivation of edible mushroom i.e. *Agaricus bisporus*, a great number of industries has been developed in the western world.

Common Indian species :—*Agaricus campestris* ; *A. bisporus* ; *A. arvensis* ; *A. latipes* ; *A. exaltatus* ; *A. pratensis* etc.

Life cycle of *Agaricus campestris*



Salient features of *Agaricus* :—

- (1) *Agaricus* is a saprophytic fungus.
- (2) Vegetative body i.e. mycelium is composed of profusely branched straws of septate hyphae, hyphal cells are multinucleate. Hyphae often form rope-like strands called *rhizomorph*.
- (3) *Agaricus campestris* is homothallic.
- (4) Basidiocarp i.e. fruiting body consists of two parts viz., (a) stalk-like *stipe* bearing annulus towards upper part and (b) an umbrella-like structure at the top of stipe called *pileus*. Pileus bears on the undersurface pink or purplish-brown-coloured, thin, plate-like structures called gills or *lamellae*. Mature basidiospores are 1 or 2-nucleate, more or less kidney-shaped, 4 or 2 in number and purple-brown in mass. Basidiospores are discharged violently by water-droplet mechanism.