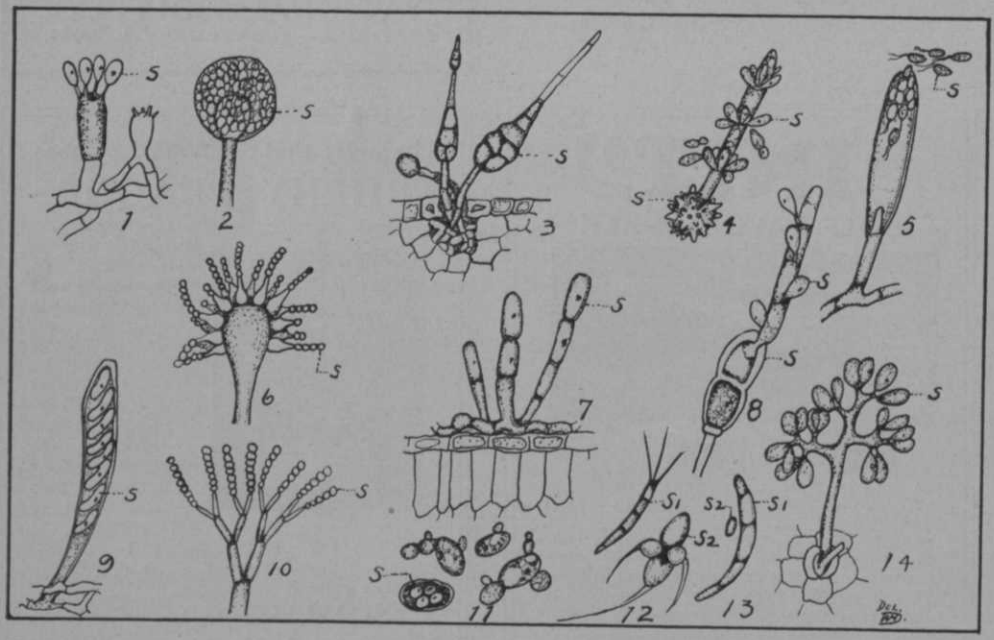
Fungi Facts for Greensmen

By DR. W. H. DAVIS
(*Edited by Prof. L. S. Dickinson*)

HOW often have we exclaimed, or heard others say, "Oh, look at those pretty toadstools! Where do they come from and what do they do anyway?" Yet, how often have we failed to obtain a satisfactory answer or give others a clear explanation to this question. The reason being that a knowledge of fungi is not commonplace but is generally possessed by a few specialists, mycologists, who are generally too busy with other affairs to be bothered with what seems to them an explanation of the A, B, C's of their subject. However, an explanation of just what fungi are and "where they come from" should be commonplace, but this explanation is not so elementary as mycologists generally believe.

What Is a Fungus?

A fungus is a plant which has no true root, stem, leaf or flower. Then one might ask, what has it? Instead of roots with tiny cells to gather food and water from the soil, a fungus has microscopic thread-like structures, hyphae, with cells placed end to end represented by the joints of a finger. An unorganized mass of hyphae is called mycelium. Hyphae penetrate rotting plant parts, manure and other organic materials and living plant parts to obtain their food. If hyphae of a fungus take their food from dead plant and animal materials, the fungus is said to be saprophitic, but if they penetrate living plant and animal parts, kill and use them for food, then this fungus is parasitic.



Types of spores and how they are formed on some fungi. (1) Basidiospores on a basidium or club. The spore stage of large brown-patch. (2) Spores of a bread-mold in their case; as many as 70,000 in one case. (3) Spores of an Alternaria which forms leaf spots on potatoes. One of our largest type of spore. (4) A spiny timothy smut spore; germinates in water and forms sporidia or spring spores. (5) Zoospores, which swim in water like pollywogs, escaping from their "egg case" or sporangium. (6) Spores of fruit mold, on club-like structure supporting many "ninepins" or spore bearers. (7) Spores of a powdery mildew on leaf. When end spore is expelled, cell below may form another spore. (8) A winter spore of clover rust forming a germtube with sporidia for spring propagation. (9) An ascus or sack with its 8 spores; note orderly placement. Surrounding fruiting body omitted. (10) Spores of blue fruit mold, formed on tree-like branches of a hypha. (11) Ascospores formed in yeast cell; other cells forming new plants by budding. (12) S1, S2, spores of Pestalozzia which appear like insects. (13) S1, large crescent shaped spore and S2, small spore of snow mold. (14) Spores of downy mildew.

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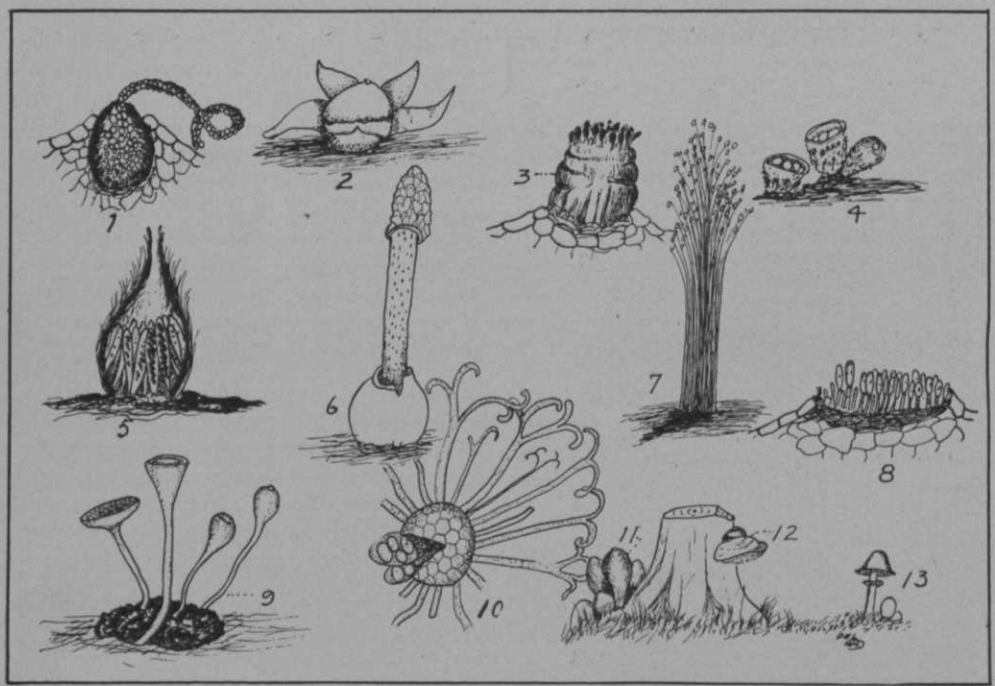
So one can see that these hyphae do not make food for themselves but destroy food already made.

But haven't fungi stems? When we mention stems of plants, we think of bark and wood as in a tree or perhaps the hollow stems of grasses with knots or nodes. Fungi have no such structures as these. Even the so-called stem of the mushroom is not wood, does not have joints and pith like corn and grass, but is composed of thousands of small threads or filaments of clear white hyphae lying side-by-side. This material is similar to the unseen feeding hyphae which are located underground. In most fungi, such as cause rusts, smuts, blights and leaf spots, there is no structure that compares in shape and use to a plant stem. In these fungi, the plant consists only of hyphae and spores.

It is easy to see that fungi have no leaves. Leaves of plants manufacture starch and sugar. Yes, we might say most woody material is manufactured in the green which resides in leaves. Without green chlorophyll, in due time, the earth would become destitute of plant and animal life. Even the fungi could not exist, for nothing would remain to manufacture their food for them and they cannot do it for themselves. Some fungi possess colored sap in the cells of their hyphae and color in the walls of hyphae and spores. The brown color of the big brown-patch organism, *Rhizoctonia solani*, is due to brown cell walls of the hyphae. Yet, some fungi are blue, green and red like the fruit and bread molds, wood staining fungi and the scarlet cup which we find in the spring on rotting twigs. However, no green chlorophyll is found in them, and they cannot manufacture food like leaves.

Let us search among the fungi for fruits or fruiting bodies which contain seeds or spores. Here lies the most fascinating phase in the study of fungi. The fruiting bodies are most fantastically formed, and it is by them and their spores that the fungi are recognized and named, since one can distinguish very few fungi by



Common fruiting bodies of fungi. Some highly magnified, others reduced. (1) Pycnidium of a Phoma belching spores volcano-like. (2) Earthstar, Geaster mirabilis, on forest soil. (3) Sporodochium on apple twig. (4) Birds nest fungus on rotting twig. (5) Perithecium with sack-like asci containing ascospores. (6) Stink-horn, correctly named, growing on sawdust. (7) Coremium or bundle of hyphae each of which bears a spore. (8) Acervulus or knot of hyphae which forms spores. This fungus has two types of fruiting bodies (Nos. 5 and 8). (9) Cup-fungus growing from hold-over mass of hyphae. (10) Perithecium, or case containing sacks with spores; often very complicated and beautiful. (11) Pear-shaped puffball; this and other puffballs are edible. (12) Woodrot on a stump. (13) Mushroom and two "buttons."

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their mycelium alone. Some of these fruiting bodies are represented by the common mushroom, which is to be seen above ground, but the principal part of the plant, the feeding hyphae, are in the soil below; other fruiting bodies are represented by the hard, warty growth on the trunks and limbs of trees. Some fruiting bodies appear coral shaped; some soft like the flesh of an ear (*Auricular judis-aurae*) but most of them are microscopic and too small to be distinguished in detail by the unaided eye. Some common forms of fruiting bodies viewed through a microscope are as follows: a jug, a door mat, small cup, bird's nest, an egg, sack, fingers on a hand balancing oranges on the tips, tail with spear head on the end, bundle of wheat, a drum-major's baton covered with marbles, a bunch of white grapes, a white leafless tree with white apples, miniature volcanoes emitting red and white lava from their craters, sea urchin, octopus and various other fantastic forms, each bearing spores attached to some part.

Fungi Structures

Fungi have structures which are comparable to seeds, and some believe these reproductive bodies, the spores, should be called seeds instead of spores. In each viable grass "seed" is found a little sleeping grass plant, and in each apple seed is a miniature fungous plant or a hypha, which generally consists of one cell. This sleeping fungous plant is covered with a spore wall, but differs from a seed, in that it has no root, stem or leaf, which are necessary for a seed as we ordinarily think of it.

The spores of fungi are as interesting to study as the seeds of grasses, weeds, vegetables and flowers. They vary considerably with respect to number, size, shape, color and form. The number of spores in one spore case of the bread mold fungus, *Rhizopus nigricans*, has been estimated as 70,000, and there may be thousands of these spore cases on one small piece of infected bread. It has been stated that a good sized shelving fungus on a tree trunk may shed more spores than a man could count in his life time, if he counted 8 hours a day and 6 days per week. Several pecks of smut spores have been removed from a threshing machine and each thimbleful of them probably contain many millions. A timothy head may form from 20 to 200 seeds,

and there may be several heads on one timothy plant, but one of its leaves infected with timothy smut may contain millions of smut spores. Fungous spores generally outnumber the agricultural seeds, someone has said, "yes, a million to one."

As most spores are microscopic, their shapes and sizes would be unknown to those who did not have access to a microscope. Very few spores can be seen with the trained eye; however, we have one fungus that bears spores which are just visible to the unaided eye. Some of these spores are one-sixth as long as the diameter of the lead in a lead pencil. Spores of fungi may vary in length from one-third to one-one-thousandth of a millimeter or from 330 to 1 micron. If one were given clay to mold some of the best known shapes of spores, he would imitate the following objects: a big club, a sack, a horn, a new moon, a slim needle with joints, an egg, an arrow head, a marble, a link of sausage, a pin cushion filled with needles, a loaf of bread, a biscuit, a pollywog swimming, a small shot, a bullet, a chain of beads, a pawnbroker's sign, a worm, a star, a beetle and a bee.

Colors are always interesting and add to the beauty of objects in nature. Some spores are white as snow, while others are as black as ink; while some are various tints and shades of the rainbow. However, some spores which appear nearly white when viewed through the microscope are decidedly colored when in a mass. The spores of fruit and bread molds illustrate this fact; in mass some are green, some blue and others salmon colored, but when viewed through the microscope all appear hyaline or white. Our common mushrooms are classified according to their spore colors; white, black, brown, rusty, lemon, rosy, red, purple, violet. Masses of these spores often give to a fungus its color by which it may be distinguished.

Spore Germination

When spores germinate they generally send forth a hypha; however, some spores send out free swimming cells, zoospores, appearing like minute pollywogs which sooner or later form hyphae. One fungus may have as many as five different spore forms. The stem rust of wheat and grasses may have two spore forms on

the English barberry, two on grass plants, and one develops from a winter spore. This gives this fungus a very complicated life history with two plants as its hosts.

Spores have never been found connected with the life history of some fungi as *Sclerotium rhizodes*, which causes the silver tip of our grasses. Furthermore, for a long time the large brown patch fungus, *Rhizoctonia solani Kühn.*, was thought to be sterile but soon after 1903, French and American mycologists accepted the fact that spores are sometimes formed on club-shaped structures, basidia, and then they renamed the fungus, *Corticium vagnum B. & C.* The fungus that often causes snow mold, *Fusarium sp.*, has at least three spore forms in Massachusetts; globose and prickly, large crescent shaped and small, nearly globose spores. Thus the spores of fungi are "fearfully and wonderfully made."

A gentleman caller asked the other day, "Aren't there more of these fungi than there used to be?" Apparently, there are, but in reality, no; for we are more alert to their presence and more familiar with their ways than formerly. Also, an elephant is easier detected in the jungle

than a mouse. The small and the microscopic forms of life are the ones generally neglected by man when dealing with nature. Most of the fungi are small, like the mouse; however, the mushrooms and some of the wood destroying fungi are sufficiently large, like the elephant, for man to observe, and these were the forms recorded by man in literature. Previous to the Revolutionary war, only a few hundred species of fungi had been specifically named, but now one writer has estimated the number as 100,000, while another places the species and forms as 200,000. The flowering plants number about 135,000, but most mycologists believe that there are generally more species of fungi than flowering plants in a community.

Geographically, fungi are found "in the utmost recesses of the earth." Spores and yeast plants have been collected in an aeroplane several thousand feet above the earth's surface. Ross Marvin told the writer that he collected fungi and yeasts in the polar regions while accompanying Peary. From the polar regions fungi are distributed over the earth's surface even to the deserts in the tropics. Some of the substrata or materials on which fungi grow might be mentioned: water, fish, frogs and insects, feces of animals, hoofs, horns, feathers, flesh such as eyes, ears, nose, lungs, liver, intestines and skin; in milk, fruits, nuts, vegetables, silage, fodders, cereals, grasses, potatoes and soil; wood in houses, barns, posts, poles, woodpulp, cordwood, and various other materials and plant parts too numerous to mention. In general, we might say that fungi are omnipresent.

Fungi are useful as well as harmful to man. Mushrooms are used for food; corn smut is fried and eaten by some tribes of Indians; a blue mold, *Pencillium roqueforti*, is used in manufacturing roquefort cheese and can be seen in the cheese, while other blue molds are used to ferment garbage and manufacture acids. In Russia, Japan and other countries fungi are used to ferment certain beverages; yeast is a fungus extensively used in the baking and brewing industries and it is prepared in various ways as a food for its vitamin content. Furthermore, fungi have been used to parasitize and exterminate various species of undesirable insects; fungi changes the old fallen wood in the forests and plant parts into plant foods.