Fungifama

September, 1997 The newsletter of the **South Vancouver Island Mycological Society** Volume 4.8

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Dues: $15.00 per year per household; after July $7.50. Please make checks payable to SVIMS or bring cash to meetings.

Meetings: First Thursday of every month (except December, January, July, and August) 7:00 p.m. Sharp at the Pacific Forestry Centre, 506 West Burnside Rd., Victoria. Parking is plentiful, and the meeting room is by the entrance. Non-members are welcome.

We were treated to an immense and enjoyable range of colour slides at the September meeting. Mary Hampson emerged as the consensus winner of a Vancouver Mycological Society Mushroom Cookbook, Congratulations, Mary!

UPCOMING EVENTS

MEETING Thursday, October 2nd

One of North America's most distinguished experts on cup fungi (Discomycetes), Nancy Smith Weber, of Oregon State University, will share some of her varied mycological experiences with us. Nancy is the author of what we think is the best book yet written about morels - "A Morel Hunter's Companion." We hope that she will bring some copies of her book with her, and she will be prepared to autograph your copy.

Also - please don't forget to bring a mug for coffee break, and remember that we always appreciate samples of your home-made goodies!

FALL FORAY October 11th-12th

This year's joint SVIMSA/MS fall foray will be held in a variety of habitats ranging from the dunes of Long beach to the depths of neighbouring old-growth forest. Officials from the Long Beach Model Forest Society will help us. Tentatively, we plan to use the Model Forest Interpretive Centre as our rendezvous point, mushroom display area, and site for possible dinner on the night of the llth. Accommodations and meals will be largely your choice (b&b, camping, motel). A list of accommodations and a map will be circulated with the registration form.

VMS MUSHROOOM SHOW October 19th.

Van Dusen Botanical Gardens, Vancouver 11 am to 4 pm 37Th & Oak.

SVIMS MUSHROOM SHOW Sunday October 26th

at the Swan Lake Nature Centre, 10 a.m. to 4 p.m.

Alert! We need lots of members out collecting, identifying and labelling the day before the show. Please contact Hannah Nadel at 383-6405 or Richard Winder at642-7528. Collecting trips start from Pacific Forestry Centre north parking lot at 8 a.m. On Saturday 25h October. Car pooling will be possible. Any mushrooms you collect on your own can be brought to Swan Lake Nature Centre between 3 and 10 p.m. on Saturday. We would also like to repeat our successful bake sale; please bring baked goods on Saturday oi on Sunday morning. Volunteers will be needed during the show at the parking lot, the bake sale, the membership table, identification table and at the display.

The show is one of the highlights of our Club year. It always brings in a good crop of new members, and helps to educate the general public about fungi. Anyone who has been involved in the show can tell you that it's an exciting event, and an opportunity to see the most mushrooms of the entire year. So please get involved, and help to make it the best show ever...

MEETING Thursday, November 6th

Bryce Kendrick will give one of his inimitable talks, titled "What is this Biodiversity all about, anyway?" This will also be the AGM. Please come and vote.

WHAT ARE FUNGI? (Part 2)

So where were we? Oh yes, I had given you a long lead-in discussion, and finally presented you with a definition of fungi, as many mycologists now conceive them. Here it is again:

"Fungi are heterotrophic (they cannot make their own food, as plants can), eukaryotic (they have complex cells containing specialized submicroscopic "appliances" such as mitochondria, for doing special housekeeping jobs, as well as sets of chromosomes, which carry most of the DNA, inside nuclei), and they absorb their food (they do not "eat" or ingest it). Fungi have a rather diffuse, indefinite body (often called a thallus or mycelium or colony) made up of branching, tubular elements called hyphae. Fungi produce detachable, often unicellular reproductive structures called spores (rather than the more complex seeds or embryos formed by plants and animals)."

Then I told you that having gone to all that trouble to define them, we were still left with a mixed bag containing members of not one, but two of the five living Kingdoms.

My job this time is to clarify that non-trivial issue. Hold onto your seats! I promise that if you stay with me (and perhaps ask me - maybe by E-mail [mycolog@pacificcoast.net]- about things that confuse you) you will gain a new perspective on the fungi. What lies ahead is not easy reading, but I hope you think it will be worth the effort! If you work your way through it, it should expand your understanding of the strange beings we all study...

For the sake of clarity, I should begin by defining the terms I use for the highest ranking taxa of living organisms: Phylum, Kingdom, and Empire. An Empire is one of only two or three basic divisions of living things, each of which is characterized by drastically different kinds of organization at the ultrastructural and biochemical level. An Empire will, in all probability, contain millions of taxa. Empires probably evolved their distinctive characters billions of years ago. In particular, Empires such as the Eukaryota and the Prokaryota (which I mentioned in the first article) became separate well over a thousand million years ago. A Kingdom is a usually large and inclusive group of taxa - such as Animalia - that share the same kinds of organization and ways of getting food (in the case of the animals, eukaryotic, multicellular structure, a unique kind of embryology, and a heterotrophic, often phagotrophic (that means, ingesting or swallowing their foodl mode of nutrition). The five Kingdoms commonly recognized by biologists resulted from evolutionary divergences within Empires, and therefore evolved more recently than their group of origin. A Phylum, of which almost 100 are now recognized, is usually a large (but occasionally a small) group of organisms, all members of which are perceived by biologists to represent a single major line of evolution, focused by selection pressure into a particular developmental/ biochemical/nutritional pathway. The members of a Phylum tend to share microscopic, and often macroscopic, patterns of organization, and unique structures. For example, all members of the Phylum Cnidaria [Animalia] are diploblastic (their bodies are made up of two distinct layers of cells, as opposed to the three layers found in more complex animals like ourselves), they are radially symmetrical, and they have specialized stinging cells - you will recognize them when I tell you that they include sea anemones, jellyfish and corals. Interpretations of Phyla vary widely: members of the small Phylum Ctenophora (Animalia) – the comb jellies, such as the sea gooseberry - are all relatively similar, and are easily grouped together by the average student of biology, while the Phylum to which we humans belong, the Chordata, contains both Homo sapiens and the rather dissimilar (not to stretch a point) sea-squirts. Nevertheless, we and the sea-squirts (Ascidians) both have a notochord (a kind of precursor to the backbone and spinal column) during embryological development, so the concept of this, as of most other Phyla, appears fairly stable and is widely accepted, despite the fact that some people would be offended to learn that sea-squirts are in their family tree (albeit a few times removed).

To get back to the fungi for a second, Kingdom Eumycota embraces only a few Phyla, while Kingdom Protoctista contains more than 35 Phyla – it is a great collection of biological experiments; a multitude of different designs for single or colonial eukaryotic cells, and some of them have also been called fungi. Until fairly recently the name "fungus" was applied indiscriminately to all members of an amazingly diverse assemblage of no fewer than NINE (9) Phyla: (1) the myxomycetes, commonly though inappropriately known as slime moulds [Phylum Myxostelida - Phylum names given here are those adopted in Kendrick (1992) The Fifth Kingdom 2nd Edition]; (2) the labyrinthulomycetes [Phylum Labyrinthulida] known, at least among mycologists, as net slime moulds; (3) the acrasiomycetes [Phylum Dictyostelida] known to mycologists as the cellular slime moulds; (4) the plasmodiophoromycetes [Phylum Plasmodiophorida] which mycologists and plant pathologists call the endoparasitic slime moulds; (5) the microscopic chytridiomycetes, which have no common name [Phylum Chytridiomycota]; (6) the hyphochytridiomycetes, likewise minute and unknown to most humans [Phylum Hyphochytriomycotal; (7) the oomycetes [Phylum Oomycota] known to many as water moulds, and in their terrestrial incarnations as the causal agents of downy mildews and damping-off diseases of plants; (8) the zygomycetes [Phylum Zygomycotal which include some common agents of food spoilage, widely known as "pin moulds," many dung-inhabiting fungi, and others which attack insects; (9) a huge assemblage [Phylum Dikaryomycota] -comprising more than 90% of all known fungi—

which includes two major subphyla: the ascomycetes (cup fungi, morels, false morels, ergot fungi, ergot fungi, powdery mildews and many-other groups which generally lack common names), and the basidiomycetes (incorporating such well-known organisms as mushrooms, bracket or shelf fungi, puffballs, bird's-nest fungi, stinkhorns, rust fungi and smut fungi). Although this is frequently ignored, the ascomycetes and basidiomycetes also encompass their often separately occurring asexual phases (anamorphs), which comprise the vast majority oi the so-called "moulds," and are sometimes inappropriately and incorrectly classified as a separate group called the "Deuteromycetes.'

The lichens are also placed in the Dikaryomycota, though they are actually dual organisms involving an intimate relationship between mostly ascomycetous fungi and green algae - (Chloroprotista) or blue-green a[ae (Cylnobacteria). Lichens are classified with the Dikaryomycota because over 90% of every lichen thallus is fungal and because the major reproductive structures are recognizably fungal (in most cases ascomycetous). In addition, a very large number of fungi (about 18,000) have become lichenized, while the number of lichenized algae is very small by comparison.

Most yeasts and yeast-like fungi also fit into the Dikaryomycota (some of them actually do make fairly normal-looking hyphae, though many don't, producing a unicellular morphology that has evolved many times in different fungal groups in response to environmental pressures - Kendrick 1937). Many yeasts are basically anamorphic fungi, and most yeast cells are conidia, as pointed out by von Arx (1979) and Kendrick (1992).

About the only rhings the original nine phyla had in common were: (l) they were all eukaryotic—they they had membrane-enclosed nuclei and several kinds of internal "appliances" such as mitochondria, none of which are found in prokaryotes - and could therefore all be accommodated in Empire Eukaryota, and (2) they were all studied by an equally diverse spectrum of people who nevertheless all called themselves “mycologists." A fairly serious problem emerging from this confusing aggregation was the near-impossibility of producing a good, consensual definition of a fungus. Ironically, the only one that offered itself was deeply flawed: 'Fungi—organisms traditionally studied by mycologists." In other words, a fungus was whatever a mycologist decided to call by that name! One might conclude that these people were being somewhat arbitrary—even cavalier—in their dealings with such a diverse bunch of organisms. Mycologists of different persuasions clearly had different interpretations of what constituted legitimate mycological territory.

As a teacher I found such vague boundaries intolerable. How could I explain such a conceptual mess to my students? In search of a defensible rationale, I looked elsewhere in biology for inspiration, and I found it in another group about which I have also taught for many years - the algae. Here was a group with a single name, yet whose members weren't even uniformly eukaryotic, because they included the prokaryotic blue-green algae, which are now widely known as cyanobacteria, as well as diverse phyla of Protoctista. The reason for this inclusion was not far to seek. All 'algae,' are, or at one time clearly were, photoautotrophs - all have, or had, chlorophyll. This, combined with their tendency to grow in water, and the general simplicity of their reproductive structures, allow us to refer to all members of an otherwise extremely diverse group under the sobriquet “algae” which carries broad implications for their life strategy and ecology.

Could some similar pattern link the nine phyla designated as "fungi.? Clearly the answer is: No! It did not matter what characteristic or group of characteristics I chose, there were always groups that did not share them. Ultimately I found that I had to exclude several of the nine phyla in order to arrive at any coherent, definable concept. I took a leaf from the algal book in stressing what we may call the “life strategy" or ecology of the group. It seemed to me that the basic module of the great majority of organisms recognizable as fungi is the **hypha**. Most, though not all, thalli of what I shall call fungi are built up of fine, apically extending, branching tubes, usually about 3-10 microns in width, within which the protoplasm and nuclei of the organism live (and often move). Hyphal tubes are often interrupted at regular intervals by perforated cross-walls or bulkheads called septa. The advantages of this life-form can be expressed succinctly: "The fungal hypha, with it's strong, waterproof, chitinous [or cellulosic] wall, the repertoire of enzymes it can secrete at its growing tip, -and the hydrostatic pressures it can bring to bear, is ideally suited for actively penetrating, exploring and exploiting solid substrates in a manner that the bacteria, chief competitors of the fungi...cannot match. " (Kendrick 1992, “The Fifth Kingdom,”). Phyla whose members never exhibit the hyphal morphology, or some reasonable facsimile thereof, are not recognized, at least in my treatment, as fungi. In addition, since the hypha by definition absorbs food rather than ingesting it, any phyla whose members ingest or engulf food particles are also excluded.

We have now arrived at the reasonably concise definition which I gave in the first of these two articles, and repeated at the top of this one. Now let's see how many of the nine phyla I mentioned earlier are still recognized as fungi. The answer is four. Phylum Chytridiomycota, phylum Oomycota, Phylum Zygomycota, phylum Dikaryomycota.

Not long ago, we put the first two of these Phyla into the Kingdom Protoctista, and the other two into the Kingdom Eumycota. The

true fungi of Kingdom Eumycota, according to our definition, never produced aquatic cells which swim by means of little whip-like tails (like those of sperms) which we call flagella. Since both Phylum Chytridiomycota and Phylum Oomycota produced such cells, they were put with many other groups that do the same, in Kingdom Protoctista. The other two Phyla, the Zygomycota and Dikaryomycota, have never been seen to produce cells with flagella, so they fit nicely into Kingdom Eumycota.

The Phylum Oomycota contains the organisms known as downy mildews. Although having motile cells at one stage of their life cycles, they also produce structures that look exactly like hyphae. Because they behave like fungi, they have always been thought of as fungi. Now we know there are some major differences between Oomycetes and true fungi: (1) Oomycete hyphal walls are made of a kind of cellulose, while those of true fungi are made largely of chitin.

(2) Oomycete cells are generally diploid, while those of true fungi are generally haploid. But the physical similarities, and the lifestyle based on an extending network of branching hyphae, ensure that the Oomycetes will continue to be considered as fungi. Now the techniques of molecular biology have shown that the microscopic Chytridiomycota are related, not to other Protoctistan Phyla, but to the true fungi.

In conclusion, then, I can present a diagram showing how fungi (*sensu lato*) can be members of two kingdoms. The Phylum Oomycota is regarded as belonging to Kingdom Protoctista, while the Phyla Chytridiomycota, Zygomycota and Dikaryomycota are all placed in the Kingdom Eumycota. It is generally understood that the Oomycota (including water moulds) evolved from a completely different ancestral line than that which gave rise to the true fungi. But if anyone were to suggest that the downy mildews are not fungi, it would probably start a revolution!

Don't forget, if you have questions about this or the first article, please write to me, Bryce Kendrick, 8727 Lochside Drive, Sidney, BC, Canada V8L 1M8, or E-mail me at: <mycolog@pacificcoast.net>.

REQUEST F'OR SPORE PRINTS

Gordon Telford (595-3424) urgently needs spore prints of pine mushrooms (*Tricholoma magnivelare*) and./or chanterelles (*Cantharellus formosus*, formerly called *Cantharellus cibarius*) for purposes of culturing. In return for these, he offers a batch of his own cultivated oyster mushrooms (*Pleurotus ostreatus*).

IN MEMORIAM-PROF. CY HAMPSON

Club members will be sorry to hear of the recent death of Dr. Cy Hampson, a keen 83-year-old member whose interest in mushrooms, and all other living things, remained strong until his short final illness.

Cy was a well-known biologist who did his PhD on flying squirrels and was a professor of Zoology at the University of Alberta for many years. He became a superb natural history photographer, producing superlative photo-essays and movies on a wide range of biological subjects. He travelled to the Arctic and to tropical Africa in search of his quarry. Although the chosen mammals and birds were often elusive, he always captured them on film. He was joined on many of these expeditions by his wife, Mary, who remains an active member of the club, and is a fine photographer and naturalist in her own right.

We will miss Cy's enthusiasm and humour, but rather than mourning his death we must celebrate his long and productive life.