

An introductory guide to the study of **moulds** (fungi) by David Malloch, University of Toronto. Includes discussions of **mould** classification, methods of study, importance to humans, and identification. Picture and text keys are provided for many of the most common fungi found in soil, indoor environments, outdoor air, food, etc. Individual genera of **moulds** are described and illustrated

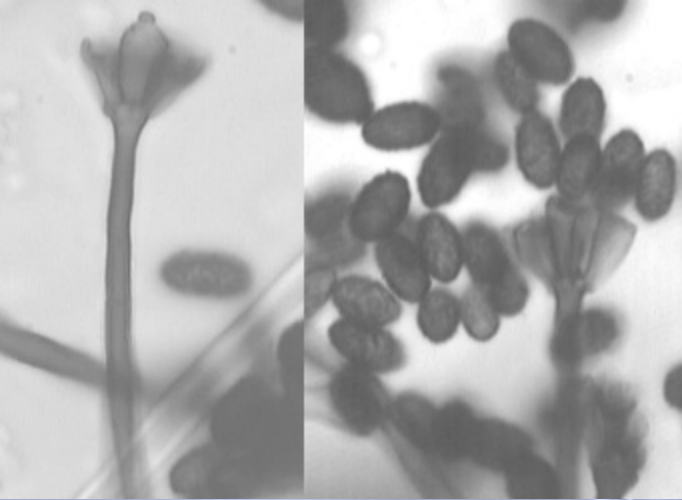
## **Moulds** in the indoor environment

Increasing attention is becoming focused on fungi in indoor environments.

Although most of the **moulds** occurring in human environments occur indoors, the interior of buildings are themselves a special habitat. It has long been known that indoor fungi cause allergies in sensitive persons, but only relatively recently have indoor **moulds** been linked to other health problems. While allergy sufferers generally react to substances in fungal spores, volatile substances released by moulds into the air may cause other health problems.

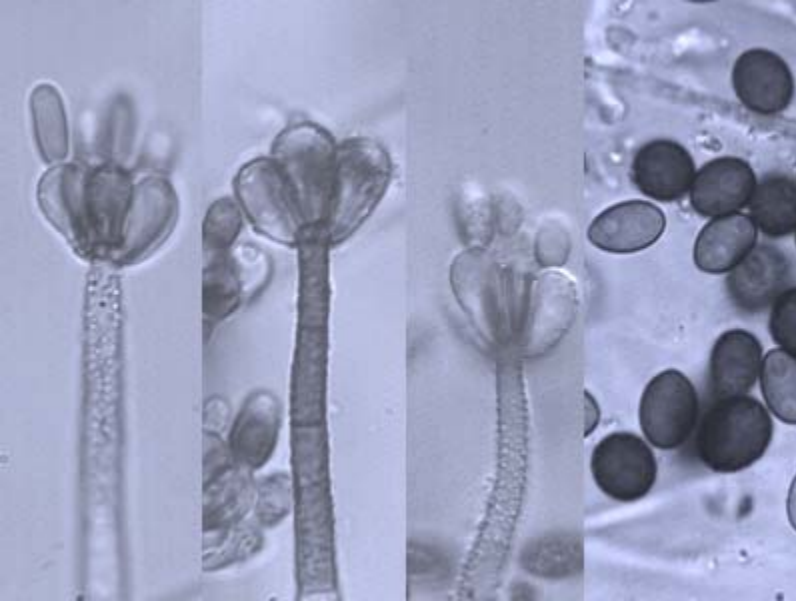
Virtually all buildings contain **moulds**, but some are **mouldier** than others. Indoor **moulds** can be remarkably tolerant of dry conditions but none can live without some moisture. Excessively **mouldy** buildings generally have a source of moisture leading to unusually heavy **mould** growth. The source of the moisture may be a leaky basement, a dripping pipe, a roof in need of repair or some other fairly obvious cause. In most cases the **mould** can be seen growing on walls or other materials in contact with the moisture. Sometimes the moisture can occur inside walls and not be apparent. A common but not obvious cause of moisture in cold climates is condensation inside north-facing walls. Severely **mouldy** buildings may have a musty smell, but not necessarily. Sometimes the only sign of a problem is persistent poor health of the occupants, such as headaches, nausea, respiratory symptoms, etc. It is now known that **mouldy** buildings can present a serious health risk to occupants. In fact, some infant deaths have been convincingly linked to indoor **moulds**. Any building with an apparent **mould** problem should be thoroughly investigated by qualified people.

Not all indoor **moulds** present a risk to human health, but an abundance of any **mould** is likely to be accompanied by others, including toxic ones. Species of



*Stachybotrys* are particularly toxic. Obvious occurrences of *Stachybotrys* may be sufficient cause for a major "decontamination" by qualified technicians wearing special protective clothing.

*Stachybotrys* species produce black colonies on dry wall, ceiling tiles and other materials containing cellulose. The easiest way to confirm the presence of *Stachybotrys* is to press a piece of cellulose tape against the mouldy spot and then examine it sticky side up on a slide under a microscope for the characteristic spore-bearing structures. The image at right illustrates conidiophores and conidia of a *Stachybotrys* species collected on tape from a basement in southern Quebec.



Not all moulds are identifiable using this

technique, but it works well for many, including *Stachybotrys*.

## *Stachybotrys*

Characterized by clusters of colourless to brown swollen phialides at the tips of colourless to brown, sometimes branched, conidiophores. The dark brown 1-celled spores (conidia) are produced successively from the tips of the phialides and collect in wet masses. Species with spores in chains are referred to *Memmoniella*. A strong decomposer of cellulose and thus usually associated with decaying plant materials.

Species of *Stachybotrys* have earned a considerable notoriety in recent years due to their production of potent toxins in [indoor environments](#). They have been linked to some cases of infant death in mouldy buildings. Rarely pathogenic for man. Holomorph: *Melanopsamma*. Ref: Jong and Davis 1976

# Animals and humans

## Diseases

A number of diseases of humans and animals are caused by mould and yeast-like fungi ([Figure 7](#)). Many are known only from this habitat and are quite specialized. Notable are the moulds called dermatophytes, the cause of a number of skin diseases such as ringworm and athletes' foot. The fungus grows on the outermost layer of skin, causing reddening of the surrounding tissues (zoophilic types) and sometimes scaliness (anthropophilic types). Dermatophytes do not normally attack deeper tissues; the symptoms are usually due to an allergic reaction. Because of their essentially non-parasitic nature dermatophytes are usually easy to grow in the laboratory. Many closely related species occur on substances similar to human skin, such as leather, feathers, hair, and horn, and are unable to grow on living animals or man. Probably the most commonly isolated dermatophytes are species of [Microsporum](#) (Figure 7A), *Trichophyton*, and *Epidermophyton*.

Several fungi can occur on living tissues and cause serious disease and even death. Many such organisms are known only from individuals who have low disease resistance, due to prior infection, AIDS, old age, or other factors. Most commonly, infections by these fungi occur when the normal bacterial populations of the body are eliminated by the use of antibiotics. Without competition from bacteria these fungi occupy the tissues and grow rapidly, often causing considerable damage.

Other fungi attack healthy living tissues without the aid of antibiotics, causing more localized but very serious infections. Histoplasmosis, a disease with symptoms similar to those of tuberculosis, is caused by [Histoplasma capsulatum](#), a mould associated with bird nests in nature (Figure 7C). It is frequently reported

in perfectly healthy people who have been exposed to the dust from nesting materials, such as while tearing down old barns.

The study of medically important fungi is beyond the scope of this book and will not be discussed further. There are several good books dealing with medical fungi from a *mycological* (rather than medical) point of view. Especially useful are Hoog and Guarro, 1995; McGinnis (1980) and St-Germain and Summerbell, 1996.

## **BLACK MOULD**

### **THE PROBLEM**

Every dwelling, irrespective of its construction, contains within its fabric **mould** spores which are dormant and completely harmless. However, given the right conditions these spores will germinate resulting in extensive growths of black disfiguring **mould**. **Mould** needs very little nutrient and will grow on walls and ceilings irrespective of the decorative finish. **Mould** spores will also spread into the air which is a serious HEALTH RISK, and give off an obnoxious musty smell. Clothes, furnishings and carpets can also be destroyed by unsightly **mould**.

### **THE CAUSE**

**Mould in the home arises from dampness, predominantly caused by CONDENSATION. However, a small proportion of problems occur due to true dampness - rising damp, penetrating damp, bursts and leaks. The incidence of condensation in domestic dwellings has increased tenfold in the last decade and is attributable to various factors - lack of heating - inadequate ventilation - use of paraffin and LPG heaters. The modernisation of properties, making homes virtually airtight and draught free with new windows and the removal of open fires, is an additional contributory factor.**

### **THE HEALTH RISK**

**Mould** in houses, even a small contamination, is a serious health risk which can result in asthma and other respiratory diseases. **Mould** also attacks foodstuffs resulting in dangerous toxins which in turn can give rise to food poisoning. Environmental Health Professional Practice - **Mould** Fungal Spores 1985 refers. The British Medical Journal report, Damp Housing, **Mould** Growth and Symptomatic Health State 24/6/89, confirms that active spores, even in small concentrations, are detrimental to the well being of adults and children.

# Introduction to Pulmonary Hemosiderosis

Over the past several years, there have been a number of young infants (most under 6 months old), in the eastern neighborhoods of Cleveland, who have been coughing up blood due to bleeding in their lungs. Some infants have died and more infants continue to get ill. This bleeding, a disorder called Pulmonary Hemorrhage appears to be caused by something in their home environments, most likely toxins produced by an unusual fungus called *Stachybotrys chartarum* or similar fungi.

## What is Pulmonary Hemosiderosis?

Bleeding in the lungs.

## What Are The Symptoms?

Severe bleeding can cause coughing up blood or nose bleeds. This is particularly concerning in infants under 6 months old. Chronic, low grade bleeding can cause chronic cough and congestion with anemia.

## What Causes The Bleeding?

Most likely, toxins made by an unusual fungus or mold *Stachybotrys*. When infants breathe in the toxins, the blood vessels in their lungs may become fragile. The weak vessels may be bothered by cigarette smoke or stresses from other illnesses and start to bleed. You cannot see the toxins in the air rather they are carried in the microscopic fungal spores.

## How Do I Know If The Fungus Or Mold Is In My House?

This fungus or mold grows only on wood or paper that have gotten very wet for more than a few days or so. (It does **NOT** grow on plastic, vinyl, concrete products, or ceramic tiles). If the wood/paper gets wet and is not cleaned up and dried, the fungus may grow and spread. The fungus is black and slimy when wet. It is **NOT** found in the green mold on bread or the black mold on the shower tiles (but the shower tiles should be kept clean too). If you have had plumbing leaks, roof leaks, flooding in the basement (even if you don't use the basement), or sewer backup in the past year, look for mold or a musty odor.

## Common Areas for This Mold Growth:

Water soaked wood, ceiling tiles, wall paneling, unpainted plaster board surfaces, cotton items, cardboard boxes, and stacks of newspapers. If these areas have been very wet, usually for longer than one week, check for mold. After the area dries, the fungus will not continue to grow, but the black dust

caused by the fungus can be sucked up by the furnace blower and spread throughout the house. Be sure and check your basement for the black mold. If you do not have access to the basement, ask your landlord for assistance. **Note: not all black mold is *Stachybotrys*, but moldy homes are not healthy homes.**

### Heating Systems:

If you have mold in your basement, check to see if there is any way that your forced air furnace can send the mold dust up to the living spaces. Is there ductwork connecting the cold air returns to your furnace or does your furnace pull air from the basement? The latter is the case if you can see the furnace filter face on (rather than just the edge).

### How To Clean-up Fungal Growth:

[Click here for more detailed instructions on how to clean-up the mold.](#) If you have more than two square feet of mold growth you should seek professional advice on how to perform the clean-up.

- The source of the water problem must first be corrected. All roof or plumbing leaks/flooding must be fixed.
- All moldy surfaces should be cleaned with a household bleach (like Clorox) and **water mix = 1 cup of bleach mixed in 1 gallon of water.** You can add a little dish soap to the bleach water to cut dirt and oil on the wall that can hold mold. With good ventilation, apply the bleach water mix to the surface with a sponge, let it sit for 15 minutes, then thoroughly dry the surface. **Be sure to wear a dust mask, rubber gloves and open lots of windows when cleaning with bleach water.**
- If the area cannot be cleaned (like some wet broken ceiling tiles), is too damaged, or is disposable (like cardboard boxes) discard them and replace with new ones.
- It may be necessary to do more clean up in the home (carpets, crawl spaces, heating ducts) if you have a bad mold problem.

**Call your city or county health department if you have questions or need assistance.**

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# THE CLEVELAND OUTBREAK

Over the past seven years in the Cleveland, Ohio area there have been 45 cases of pulmonary hemorrhage (PH) in young infants. Sixteen of the infants have died. Thirty-two of the infants have been African American. Most of these cases have occurred within ten contiguous zip codes area in the eastern portion of the metropolitan area. In November/December, 1994, the Centers for Disease Control and Prevention (CDC) lead a case-control investigation on the first ten cases. This study found an epidemiological association of PH in these infants with water-damaged homes containing the toxic fungi, predominantly *Stachybotrys*. Several lines of evidence suggest that the most likely causal agents are fungal toxins from a fungus called *Stachybotrys atra*. This somewhat unusual fungus was found in high quantity in the home environments of the affected infants but also to a lesser degree in some of the comparison homes. *Stachybotrys* requires water soaked cellulose to grow, and was found in homes where there had been water damage from flooding, plumbing leaks or roof leaks involving wood or paper products (e.g. insulation, gypsum board, ceiling tile). The spores of this fungus contain very potent mycotoxins which appear to be particularly toxic to the rapidly growing lungs of young infants. The linkage of *Stachybotrys* to PH in infants is on the basis of epidemiological data and has not been conclusively demonstrated. Other factors such as environmental tobacco smoke appear to be important triggers in precipitating overt pulmonary hemorrhage.

More cases continue to occur, a few infants having had only very subtle initial symptoms such as nose bleeds and chest congestion. Concern that there may be a larger number of undetected young infants with this disorder, led to the examination of all infant coroner cases over a three year period, 1993-1995. This revealed seven "SIDS" (sudden infant death syndrome) cases with evidence of preexisting major pulmonary bleeding. All but one of these infants had lived in the ten zip code cluster area.

This disorder is likely to extend beyond Cleveland since an informal national survey of all pediatric pulmonary centers and continued reporting has identified over 100 similar cases of pulmonary hemorrhage in infants across the country over the last seven years.

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## IS MY MOLD *STACHYBOTRYS*?

While *Stachybotrys chartarum (atra)* occurs widely in North America, it is probably rather uncommon to find it in homes. It requires water soaked cellulose (wood, paper, and cotton products) to grow. While wet it looks black and slimy perhaps with the edges white, and when dry it looks less shiny. **It is not the only or the most common black mold to be found in these conditions.** If your clean-up is not simple, i.e. your water damage and mold growth is extensive and/or involves structural materials, contact your city or county health department for assistance in assessing the problem. They can put you in contact with environmental laboratories capable of identifying *Stachybotrys* and with abatement contractors familiar with the precautions and other specifics important for extensive clean-up. If you have a large area of mold growth (greater than two square feet or so), seek professional assistance in the clean-up. You can get quite ill yourself if you inhale a large quantity of the fungal dust or get it on your skin.

### Testing for Mold

For a more detailed discussion on the assessment and remediation of *Stachybotrys* in indoor environments, please refer to The Proceedings of the International Conference held on October 6-7, 1994 in Sarasota Springs, NY entitled "*Fungi and Bacteria in Indoor Environments*", pages 201-207, published by the Eastern New York Occupational Health Program [(518)436-5511].

In cases of minor mold contamination, small isolated areas (2 to 10 sq.ft.), testing is usually not necessary. In most of these cases, the area can be addressed by using the clean-up recommendations given elsewhere on this home page.

In cases of more extensive contamination, testing may be necessary. Some private environmental consulting firms may have the ability to conduct home assessments and sample for mold identification. Please refer to the section of your yellow pages entitled "Environmental Consultants" to find a company in your area that might be capable of performing these tasks effectively. Ask if the company has experience with mold testing; it is recommended that several price quotes be obtained for field work and analysis. Consulting firms should be familiar with the American Industrial Hygiene Association (AIHA) document entitled "*Field Guide for the Determination of Biological Contaminants in Environmental Samples*". This document provides guidelines for the sampling of mold in indoor environments. For a list of accredited labs, please see the [AIHA web site](#).

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# DOES MY INFANT OR CHILD HAVE PULMONARY HEMOSIDEROSIS?

Pulmonary hemosiderosis is a rare lung disorder which can also occur as part of other medical conditions. If your infant or child is coughing blood, you need to seek medical attention immediately. If your young infant (<6 months old) is having nose bleeds without any injury, you should seek medical attention right away. If your infant or child has chronic cough and chest congestion and is anemic, ask your physician to consider the possibility of pulmonary hemosiderosis among all the other more common diagnostic possibilities.

If your physician would like more information about looking for pulmonary hemosiderosis, have them contact:

Dorr G. Dearborn, Ph.D., M.D.  
Pediatric Pulmonary Division  
Rainbow Babies & Childrens Hospital  
11100 Euclid Avenue  
Cleveland, Ohio 44106  
FAX (216) 844-5916

If your physician would like consultation regarding pulmonary hemosiderosis have them contact the nearest Pediatric Pulmonary Center. The local chapter of the American Lung Association can be of assistance if necessary.

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