

Mold Fever:
How a Bizarre Life Form Penetrated Popular Consciousness and Launched a
Creeping Hysteria

by

Jennifer Tucker Frazer

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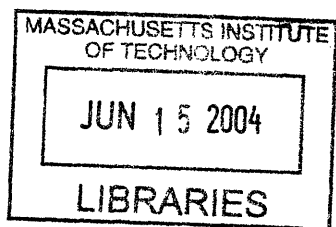
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Signature of Author: _____
Graduate Program in Science Writing
May 20, 2004

Certified by: _____
Boyce Rensberger
Director, Knight Science Journalism Fellowships
Thesis Advisor

Accepted by: _____
Robert Kanigel
Director, Graduate Program in Science Writing
Professor of Science Writing



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ABSTRACT

Molds are everywhere, lately: in our homes, newspapers, and courtrooms, and on our minds. In the past few years, mold has gone from a blip on the radar of public consciousness to a major force in home inspections, insurance, litigation, and testing. Never before have people been so concerned over a group of creatures that — undeniably — have been there all along.

This thesis — written as a four-part newspaper series — details the mold hysteria phenomenon, the biology of indoor molds, the science of indoor mold and health, and the profit-making frenzy that capitalized on mold fever.

Thesis Supervisor: Boyce Rensberger

Title: Director, Knight Science Journalism Fellowships

Biographical Note:

Jennifer Frazer graduated Phi Beta Kappa from Cornell University in 2000 with a degree in biology. While she loved biology, she loathed the day-to-day research grind, so she explored teaching, extension work, and journalism while earning her first M.S. in Plant Pathology at Cornell. After working the science beat for the *Cornell Daily Sun*, she was hooked on science writing and hasn't looked back. She completed an internship at Harvard Medical School's *Focus* before entering the MIT Graduate Program in Science Writing and will join *The Courier-Journal* of Louisville, Kentucky as a reporting intern this summer.

"Life is either a daring adventure or nothing." — Helen Keller

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I. The Genesis of Mold Hysteria

Living creatures float in every breath we take. The air is a mist of life that coats every surface exposed to it with microorganisms. This is normal.

Among these organisms are the molds — fungi that specialize in decay. In recent years, these molds have also generated a furor — a storm of fears, litigation, rising insurance premiums, and a small industry specializing in detection and remediation. This is not normal. At least, it's never happened before.

Humans have lived with molds for thousands of years in uneasy peace — especially compared with our tempestuous relationship with other microorganisms. Countless viruses and bacteria infect humans, but the number of major fungal infectious diseases can be counted on two hands. Ebola, plague, smallpox, tuberculosis, and other diseases caused by viruses and bacteria are the subjects of horrific legends and nightmares. Tinea, the fungal cause of athlete's foot, is the subject of mildly amusing low-budget commercials.

But lately molds have been getting new attention. The illnesses some people have claimed are caused by mold are more nebulous, and in some ways, more frightening. Breathing difficulties, headaches, dizziness, flu-like symptoms, unexplained bleeding, hearing or memory loss, cancer . . . the list goes on and on. And it's not just called mold anymore; it's "toxic mold."

Families come on the evening news to describe how mold has taken over their home — even their car! — making them perpetually sick. Moon-suited remediators are the only ones who enter such contaminated houses, as if they were "hot zones."

Every fall, the news media describe how some public school has developed a mold problem and must be closed for clean-up.

Books and websites warn homeowners about the dangers of "toxic molds", in particular, the black mold named *Stachybotrys chartarum* (stack-ee-bot-ris kar-tar-um).

Insidious, silent, and deadly, this new threat has emerged, some claim, to threaten our lives. Others dismiss the concern as mass hysteria, brought out of nowhere by enterprising capitalists, and unsupported by scientific evidence.

"I'm just so fascinated by this phenomenon," said Raymund King, the author of the 2003 book *Toxic Mold Litigation*. "It's really a phenomenon. I practiced medicine for about 10 years before I became a lawyer, and I see it from two different perspectives." His book, aimed at lawyers, published last July, and priced at \$102.85, sold out in eight weeks.

Whatever the true cause, marriages, jobs, and health have all been damaged by close encounters with indoor mold. The insurance industry has also taken a financial beating, as mold claims have skyrocketed nationally. And those looking to exploit or profit on mold fever have caused needless headaches and confusion, sometimes ruining the cases of those with potentially legitimate mold claims.

Why are some people suddenly consumed with fear of “toxic mold”? Have the molds changed? Have our homes? Have we? Does mold truly cause horrific health problems, or is it just hype? The truth, according to a five-month investigation by [this newspaper], lies somewhere in between.

* * *

Nancy Davis had done everything right. Before buying her first home in Pepperell, Massachusetts, in October 2002, she and her husband had inspections done and purchased homeowner’s insurance. That December, they made an appointment for an energy audit to save money on the winter heating bill. Then — in the space of a week — everything went horribly wrong.

“The inspector went into the attic and came down and said, ‘Lady, you have the worst case of mold I’ve ever seen.’ He gathered up his stuff and he literally ran from the house. He said, ‘Call your insurer.’ And I said ‘Mold? What is he talking about?’ I thought mold was something that grew on bread.”

Three days later, insurance agents and home inspectors descended.

“They were in full hazmat gear. I mean it looked like they were coming from space. It was horrible! I felt like I was in a movie.”

In another three days, she received a letter: her insurance had been canceled and refunded because the mold was a pre-existing condition. “We got a letter canceling our insurance before we even got the policy,” Davis said, “And there was nothing we could do.”

She desperately tried to find another insurer so they wouldn’t default on their mortgage, but no one would take them.

Worse still, Davis had been having health problems from the day she moved in, she recalled. Her symptoms included headaches, coughing, heaviness in her chest, phlegm, popping

ears, and skin rashes. Though at the doctor's office every other day, they didn't seem to know what was wrong with her and prescribed antibiotics. Finally, allergy tests implicated molds.

"Within two months I got sudden onset asthma, I had steroids, a nebulizer, and I was on at least eight different medications just to breathe in my own house."

Eventually, the Davises abandoned their home.

"We left everything," Davis said. "Because the spores from the house contaminated our cars, our auto insurer totaled them. These guys were in full gear in my front yard, with all these machines. In 15-degree weather, we had to take our clothes off in our front yard inside this plastic thing they had built and put on hazmat suits. And then, we wore these hazmat suits out of our front yard until we got to our new apartment. And we had nothing. We didn't have food, we didn't even have a toothbrush."

Across the country, in drought-ravaged Colorado, Linda Caserta has a similar tale of anguish.

Last November, she moved into an apartment townhouse in North Carbondale, Colorado. Weeks later, she began to feel bad and went to see a doctor. "I told him it felt like somebody was sitting on my chest — I couldn't breathe," she said.

Despite visiting several doctors and receiving a stream of prescriptions, nothing seemed to help, and no one could figure out what was wrong.

"I'd have a coughing fit for five minutes, to the point where I'm gasping for air or throwing up," she said. "I was getting so frustrated, and all I wanted to do was breathe in."

A few weeks later, Caserta lost her job at upscale Gucci. "Nobody wants you around to sell a \$7000 dress when you're coughing up a lung," she said.

She went out to the garage and happened to look up. "I saw this huge water mark where the tape and the wall come together. A light went on in my head, and I thought, "What if it's mold? Because I know I'm allergic to mold."

Despite the evidence, Caserta had a difficult time persuading both her landlord and doctor that mold might be the source of her illness.

"They think because I live in Colorado and it's such a dry climate, you can't get mold, but that's not true."

Repairmen found mold growing under her shower due to a poorly installed shower pan, but Caserta still had to face the threat of eviction by her landlord, who claimed it was a scam,

strain in her relationship, and encampment on the floor of her living room for months to avoid the moldy air upstairs.

Though the mold has now been cleaned up, it's surfaced in a few other spots in her home and Caserta says she is still experiencing symptoms.

"I don't know if I've been articulating well enough — I left out a lot of curse words," she said of her story. "But I still have this coughing and I can't breathe out of my nose. My life has been ruined, I lost my job, I have no money, and I'm living in a place that's making me sick."

* * *

It was cases like these that helped trigger a congressional hearing on mold. In July 2002, two subcommittees of the Committee on Financial Services of the U.S. Congress convened a joint hearing called "Mold: A Growing Problem".

Representatives from the building industry, the Centers for Disease Control and Prevention, the insurance industry, homeowners, and occupational health experts gathered to present their perspectives.

In her opening remarks, Rep. Janice Schakowsky (D-Ill.) said, "I was telling some colleagues of ours that I was coming here, and, to a person, they told me of a situation of pretty devastating mold contamination in their district. One Member told me about a school that actually had to be completely shut down because of mold contamination. Another told me about a building across the street from the site of the World Trade Center, some 60 stories tall or higher, that now is shut down; and they are trying to figure out what to do with it because of this toxic mold infestation."

Gordon Stewart, president of the Insurance Information Institute, an insurance industry trade group, testified to a dire situation in his industry. The latest figures available then were from 2001.

"The year 2001 was the worst in the history of the property casualty industry," he said, "but I am not here to ask for sympathy. That is the background. We estimate that in the homeowners sector the loss was about \$8.9 billion. Mold is a major factor in these increased costs. Conditions have reached crisis proportions in Texas; and mold has become a serious problem in several other states, including California, Florida, Arizona, and Nevada."

The statistics he presented were grim.

Texas was the first state to experience a rise in mold related insurance claims. According to the Texas Department of Insurance, claims rose from 1,050 in the first quarter of 2000 to 14,706 in the last quarter of 2001, a 14-fold increase. The cost to Texas insurers rose from \$14.4 million to \$187.5 million during that period.

Homeowner premiums followed suit; in Texas, after a decade of annual increases averaging less than \$50 per year, 2001 saw a jump of over \$200 per policy. In some cases, premiums have doubled or tripled, according to King.

Bob Hartwig, senior vice president and chief economist of the Insurance Information Institute, projected national mold losses in 2000-2002 based on claims from California and Texas. He estimates that losses increased from nothing in 1999 to \$3 billion in 2002. He called this estimate "conservative". He hesitated to estimate figures for 2003 because more claims were originating with businesses instead of homes, which are much harder to catalog.

Increasingly, homeowners have begun connecting their health problems to mold in their homes, and holding their insurance companies responsible.

"Health claims are coming under property policies that were never intended to cover health claims," Stewart told Congress. "And now, fearing bad-faith lawsuits, insurers are tending to throw money at mold claims because they don't want to be accused of not doing everything they could be doing and having a very expensive lawsuit."

The surge seen in other states is now reaching Massachusetts. "We've noticed a dramatic increase in indoor air quality complaints in general," said Suzanne Condon, the associate commissioner of the Massachusetts Department of Public Health, Bureau of Environmental Health Assessment. "I don't think [mold problems] have peaked or stabilized. We keep track of how many requests we get, and if anything, the number of requests is increasing."

In Cambridge, whose Department of Public Health introduced a Healthy Homes Program in January 2000, requests for home air quality inspections have been booming ever since. "The program has been a big success," said Sam Lipson, director of the Environmental Health Unit, who estimates the program has evaluated over 200 homes so far.

Attorney David Yas, editor-in-chief of the *Massachusetts Lawyers Weekly*, believes that mold litigation here is increasing. "Lawyers tell us that it's certainly a burgeoning area," he said.

"I don't see the end in sight soon," King said.

All this raises a question. Mold has been around a long time. Fungi are older than flowering plants, birds, and dinosaurs. So for as long as families have been moving into their dream caves, castles, estates and trailers, mold has been there. Yet mold litigation emerged only in the past few years.

The Insurance Information Institute put it this way: “For 399,999,998 out of the past 400 million years, mold was not an issue for litigation.” Why now?

Construction changes in houses, opportunistic lawyers, and increased media attention have all been suggested as root causes. But the origin of public awareness of indoor mold and illness can be traced to one source more than a decade ago.

* * *

In January 1993, pale, limp babies with bleeding lungs, some coughing up blood or not breathing, began arriving at the emergency room of the Cleveland, Ohio, Rainbow Babies’ and Children's Hospital.

The infants came from nearby low-income neighborhoods. When five of the children were sent home, their symptoms recurred, causing them to be readmitted to intensive care and intubated. One child died.

The Centers for Disease Control (CDC) dispatched a team to sample the homes and look for a common cause. They examined the homes of the nine infants and 28 unaffected children and distributed 240-item questionnaires.

Investigators considered many factors, including smoking, baby care practices, home water damage, drugs, and chemicals such as paints, gasoline, or pesticides. They found that cigarette smoke was present in nine out of the ten homes, and that all ten had sustained chronic water leaks or flooding in the last 6 months. Many of the wet items in the basements had not been removed; some homes still had standing water. Some contained forced air heating systems that sucked air from the basement to heat the house.

Investigators ruled out all known causes of pulmonary hemorrhage, including physical abuse. But one other clue — the red blood cells of the bleeding infants had actually ruptured — led the investigators to consider toxins.

Though they found no differences between the infants' homes and control homes with respect to household pesticides, baby products, or cocaine, the affected infants homes were much moldier. Molds were known to produce toxins. Could these microbes be the source?

The researchers speculated that a mold called *Stachybotrys chartarum* was poisoning the children.

Stachybotrys — first discovered in 1837 on wallpaper in a home in Prague — is a mold that thrives on soggy paper products, which are common in flooded homes, but had never before been connected with infant deaths.

Though *Stachybotrys* is relatively uncommon in homes, it did have one feature that drew the investigators' attention. It had been associated with respiratory bleeding before.

That was in the 1930s, when it became known for sickening people and horses in the Soviet Union and eastern Europe who had consumed straw blackened by the mold. Workers who handled infected straw experienced similar symptoms. They suffered rashes, pain and inflammation of the mouth and throat, chest tightening, cough, fever, headache, fatigue — and nosebleeds. There was one difference: the infants' blood had come from the tiny air sacs of their lungs, not from their noses or throats, as in the case of the 1930s incident.

In all cases, touching, eating, or inhaling massive quantities of the mold seemed a prerequisite to developing symptoms.

Until 1986, no reports existed connecting *Stachybotrys* in homes with illness. In that year an account was published of a Chicago family that had been experiencing cold and flu-like symptoms, headaches, fatigue, and irritated skin for five years before seeking help. The home had a history of water problems, and *Stachybotrys* was found growing in the house and its spores were in the air. When the mold was cleaned up, the family's symptoms disappeared. Investigators concluded that *Stachybotrys* had been responsible.

In the Cleveland case, *Stachybotrys* was detected in filtered air samples in 5 out of 9 of the sick babies' homes and 4 out of 27 of the controls'. But the concentrations were relatively low compared to other fungi. The homes of affected children *were* moldier — containing on average 41 times as much airborne fungi — but well over half the mold was a type called *Aspergillus*. *Stachybotrys* constituted only 0.1 percent of the mold found in homes with affected children and 0.5 of homes without.

Still, the scientists concluded after statistical analysis that there was an association between *Stachybotrys*, cigarette smoke, and the infants with bleeding lungs. “The results of our study suggest that infants with acute pulmonary hemorrhage were more likely than controls to live in homes that had molds, including [*Stachybotrys*], in the air. The spores of [*Stachybotrys*] contain potent mycotoxins (toxins from mold), and we hypothesize that pulmonary hemorrhage occurred after the infants inhaled these spores.”

Though other molds found in larger quantities in the homes were also capable of producing mycotoxins, the scientists said their analysis indicated that there were no differences in concentrations of these molds between patient and control homes.

Soon the word was out. The prospect of a mold quietly growing in homes that could potentially kill tiny children was terrifying to parents. Extensive media coverage ensued, including a CBS News special on “48 Hours” called “Invisible Silent Killers”.

In media reports and in the literature of the testing and remediation industry that soon sprang up, it was sometimes omitted that the bleeding lungs belonged to infants in smoky, low-income urban housing. It was more often implied all healthy persons were susceptible. Many ordinary people soon accepted that *Stachybotrys* was *the* mold to fear.

In March 2000, the CDC — which led the Cleveland investigation — abruptly withdrew support from the study’s conclusions after it sponsored a review, finding that the study was too small, the methodology was flawed, and the syndrome was poorly defined.

“Serious shortcomings in the collection, analysis, and reporting of data resulted in inflated measures of association and restricted interpretation of the reports. The associations should be considered not proven. . .” the CDC wrote in *Morbidity and Mortality Weekly Reports*.

The CDC also noted: “Despite caution that ‘further research is needed to determine . . . causal[ity],’ the findings have influenced closure of public buildings, cleanup and remediation, and litigation.”

The original authors posted a statement on the internet defending their research, including their use of statistics, pointing out that the CDC stopped the study early, and noting that more cases of infant pulmonary hemorrhage had occurred around the country after their initial report. Using a more stringent definition of the syndrome, they counted 30 cases of pulmonary hemorrhage and 5 resulting deaths at their hospital between 1993 and 2000.

A 2001 report in the *Annals of Allergy, Asthma, and Immunology* straddled the fence: “Although the criticisms of the study of these infants are valid and require caution in interpreting the findings, the association of this specific illness with inhalation of *Stachybotrys* spores and/or its toxin (in contrast to nonspecific health complaints in adults) is biologically reasonable.”

A 2003 paper in *Clinical Microbiology Reviews* supported the conclusions of the CDC’s review: “To date there is no sound evidence linking mycotoxin exposure to serious or permanent lung injury . . . While there are reasonable concerns regarding *Stachybotrys* exposure, a link to pulmonary disease beyond transient irritative symptoms, and in particular infant pulmonary hemorrhage, has not been proven.”

Today, it is still unresolved whether *Stachybotrys* — or perhaps some other mold — caused the Cleveland babies’ bleeding lungs.

* * *

Before the dust had settled in Cleveland, another incident helped focus public attention on mold — and especially on the pursuit of legal remedies.

“There’s one case that everyone points to as the ground zero for mold litigation — the Melinda Ballard case,” said Hartwig.

Ballard, whose moldy, multimillion dollar home was located in — ironically — Dripping Springs, Texas, sued her insurance company and won \$33 million in June 2001.

A string of pipe leaks in the Ballard home led to extensive mold growth, dizziness in Ballard, forgetfulness in her husband, and asthma in her toddler son. Her lawsuit against her insurance company, from which she was initially awarded \$33 million (later reduced to \$4 million after the medical evidence was ruled inadmissible) was widely publicized and featured in a story in the *New York Times Magazine* called “Haunted by Mold”.

A startled media reacted by publishing scores of articles on mold, and as public awareness grew, more mold was discovered, further fueling the frenzy.

“The hysteria and the news was out that the black mold was the killer mold and everybody got sensitized to the fact they didn’t want mold in their house,” said Ray Petrisek, director of environmental microbiology at HP Environmental, a firm that performed toxicology assessments on the World Trade Centers both in 1993 and 2001. “You can’t turn on TV without

seeing someone burning their house down because of mold, or the mold monster, or the black *Stachybotrys* scare. But you can't open a refrigerator or go in a shower that doesn't have yeast or mold in it."

Assistant Commissioner Condon believes most of the rise in mold complaints is a result of increased perception and awareness. "I think people have seen a lot of media coverage of some particularly horrific cases."

When he gives presentations on mold, Hartwig labels the phenomenon: "The Media and Mold: A Marriage Made in Heaven." The lure of something alive, alien, and associated with decay is just the sort of thing to grab reader's attention in a way that something like asbestos, a mere chemical, never could.

Headlines such as "Haunted by Mold" and "Nightmares on Mold Street" from the *New York Times* were just as disturbing to their readers as "WE'VE GOT KILLER MOLD" was to *New York Daily News* readers.

But for all the hype, there has been very little science informing the debate. Does mold cause health problems or doesn't it? If so, how? Ultimately, the biggest casualty from mold fever has probably been the facts.

TOMORROW: The natural history of mold

Sidebar: Molds in Massachusetts

Although there have been several media accounts of families abandoning their homes in the Bay State over the past five years, it was only this fall that Massachusetts saw its first jury award for mold for \$549,326, according to David Yas, editor-in-chief of *Massachusetts Lawyers Weekly*.

But reports of molds at local schools and even at the Big Dig have peppered the papers in the last few years.

According to Sam Lipson, director of the Environmental Health Unit for the Cambridge Department of Public Health, the most common cause of moldy homes in Cambridge and Somerville homes is poor maintenance, which leads to the water problems that inevitably cause mold trouble.

“Rent control had a big influence on the physical condition of homes in Cambridge. Landlords had little incentive to do maintenance because there was no return on their investment,” Lipson said.

Because of the rising cost of living in Cambridge, landlords found it profitable to subdivide apartments and rent out spaces that were not previously inhabited, nor intended to be inhabited, such as basements.

Frequently, these slapdash apartments lack proper ventilation, which contributes to increased humidities that favor mold growth. But the pressure to find an affordable place to live can be huge, especially for poor families, which forces them to accept unhealthy living conditions.

“We’ve seen mushrooms growing in apartments, whole ceilings coated in mold, including *Stachybotrys*, and people living in basements where the carpets are always soaked,” Lipson said.

Mold is also a problem in Massachusetts schools, scientists say.

“Schools have their own special problems,” said Michael Muilenberg, a research associate who studies indoor air contaminants at the Harvard School of Public Health. “Maintenance budgets are low. They were built 40 years ago. They often have flat roofs almost inviting moisture problems.”

A 1998 survey of 118 Massachusetts elementary schools conducted by the state’s Department of Public Health found that 68 percent of principals reported previous indoor air quality problems, and of those, 34 percent involved mold, or 23 percent overall.

Molds are well known triggers of allergies and asthma, which is particularly troublesome when young children are involved.

The rate of asthma at schools with reported problems was 7.8 percent, but only 5.9 percent at unaffected schools. But correlation, as researchers stress, does not equal causation, and it is possible that schools with more asthmatic children are simply more sensitized to detect problems.

II. The Natural History of Mold

On a bright, chilly December day Mike Muilenberg was at work in his basement laboratory at the Harvard School of Public Health. He is a tall, quiet man with a long gray beard

and an easy smile. Muilenberg studies allergens and their relationship to asthma. Among other things, he works on mold.

On his office floor was a copy of *Mycologia*, the premier fungal research journal. The cover photo was a Christmas tree in a petri plate, a seasonal confection fashioned entirely out of different colored molds by a lab technician with surgeon's hands, impeccable sterile technique, and a sense of humor. The molds in the scientist-artist's palette, like all molds, are fungi (pronounced fun-ji), members of a vast kingdom of life, quite different from plants.

In fact, scientists who have compared genes of plants, animals, and fungi now believe that fungi are more closely related to animals than to plants. That is not to say they are close relatives; animals and fungi likely split apart a few billion years ago, while still ocean dwellers.

The fungi are a bizarre collection of organisms, many of which have appropriately quirky names. There are puffballs, earthballs, and earth stars, stinky squid and stink horns, bracket fungi, coral fungi and bird's nest fungi (complete with spore packets that look like eggs inside a brown "nest"), and mushrooms with gills, spikes, ribs, or pores underneath their caps.

There are cup fungi and jelly fungi, which are rubbery and as brightly colored as children's toys. Fungi also include the rusts, smuts and bunts, which are pernicious plant pests. Yeasts are the most domesticated of the bunch. Humans employ them to crank out huge quantities of bread, beer, wine, soy sauce, and tempeh each year.

The term "mold" is a little slippery — it is not a scientific classification based on relatedness but rather based on form. One way of defining molds is by what they do — a mold is any fungus associated with deterioration of food or manufactured goods. Usually, it exists as a network of fine threads.

On a wire rack and on a table in Muilenberg's lab, plastic petri dishes were stacked in rows, filled with molds growing on malt extract agar, a tan gelatinous substance on which molds feed. The plates are covered in a riot of pink, red, yellow, green, gray, brown, black, and white, in various patterns resembling spilled paint.

All of these molds came from people's homes. They were collected as part of an asthma study. Muilenberg and his assistants have gone into the homes of 500 asthmatic children from low-income families and sampled the fungi there. They have found an association between respiratory infections in these children and higher indoor mold counts, though he notes that this doesn't prove the fungi are the cause.

Muilenberg and his assistants use a Eureka Mighty Mite vacuum cleaner fitted with an attachment called a carbon finger to suck up spores inside homes. They wash the filter, then dilute the wash several times before taking a bit of this solution and spreading it on their plates. Then they wait.

Within days, tiny white fuzzy spots start to appear. In a week or so, the entire plate is coated with fungi. Each patch of fungus — which could have originated with one spore or a cluster of spores — can be counted, identified, and matched with the data on the health of the children in a particular home.

“That’s *Stachybotrys*,” Muilenberg said as he pointed to an innocuous looking plate sealed with a thin plastic film. *Stachybotrys* — the black mold notorious for its association with the infant deaths in Cleveland, Ohio — was a homely, pale fuzz speckled with black. The patch of fungus on the plate resembled nothing better than thinning, graying hair.

Muilenberg carried the plate to a microscope and peered inside.

“*Stachybotrys* forms what people call slime balls,” Muilenberg said. Irregular black globules — clusters of the fungus’s spores — lay scattered through the filaments like glistening drops of tar on tangled fishing line. Even for a mold, *Stachybotrys* would win no beauty contests.

A fungus’s body is not like any we know. A trout or a lily has a discrete, compact body that we can easily recognize. But fungi evolved along different lines, partly due to their feeding style. Animals ingest their food; fungi infiltrate it. They secrete enzymes that digest food outside their bodies, then the fungi absorb the products. This means that surface area is crucial; the more fungal surface area, the larger the volume in which the fungus can feed. So while animal and plant cells are generally stacked together like beans in a barrel, fungal cells grow in filaments. They can grow only from the tips of these filaments by elongation or branching.

All the filaments belonging to a particular fungus constitute the fungal body. A mushroom is just a reproductive structure like a flower; both fade quickly, while the rest of the organism lives on. Out in the forest, fungi are commonly buried inside wood, in soil, or wrapped around tree roots. Most times, you can’t see them. You walk over hundreds of them in the forest, and consume and breathe countless spores every day.

“One of the reasons we see *Stachybotrys* so commonly on wet building materials is that it easily makes the enzymes needed to break down cellulose,” Muilenberg said, referring to the

plant fiber that stiffens pine trees and paper alike. “Many of the other fungi don’t have this — they’re living off dirt in the carpet or on drywall binder.”

Muilenberg keeps samples of other molds isolated from homes. *Aspergillus niger* had large round spore masses that looked like blobs of coffee grounds. *A. nidulans* was a smaller version with pea-soup green clusters.

A grayish felt residing in the same plate was a *Penicillium* species, a member of the group that brought us penicillin after Alexander Fleming found it staking out turf on what was supposed to be a bacterial culture. Though they grew in abundance elsewhere on Fleming’s plate, there was a ring of dead bacteria around the mold. That gave Fleming an idea, and that idea — made reality by antibiotics such as penicillin — allows millions of people to be walking around today who would otherwise be dead, the victims of bacteria.

All of the molds on Muilenberg’s plates are producing spores in abundance. A spore is just a specialized reproductive cell, furnished with a food supply, a sturdy coat, and sometimes sunscreen in the form of pigment. Mycologists have dozens of names for spores — ascospores, basidiospores, conidia, and so on, depending on the group of fungi forming them and whether or not they were produced sexually. With a slight breeze, most of these spores could be carried off into the wind, which is why the plates are sealed. And just what’s in the wind is what Mike Muilenberg studies.

For a current study, he’s sampling air on the roof of the Worcester Medical Center to see whether the number of fungal spores and pollen grains in outdoor air corresponds with increased emergency room visits. He uses a device called a Burkhardt sampler, which is an enclosed metal drum coated in a sticky plastic film. As the drum slowly turns, a gentle vacuum pulls air in through a slit in the roof of the enclosure, and spores strike and stick to the film, thus providing a chronological record of air content.

The film is snipped into slide-sized segments and viewed under a microscope. What’s on these slides represents the contents of every breath inhaled by the people of Worcester.

Muilenberg showed off one such slide. It held many dark, irregular globs resembling grape clusters — the exhaust products of automobile and truck engines and power plants. There was a broken pollen grain, looking like an empty water balloon. Scattered densely over the slide were hundreds of fungal spores, like tiny Christmas ornaments in a variety of shapes, sizes, and colors. There were mushroom spores and shelf fungus spores, and plenty of mold spores.

Muilenberg's practiced eye could identify many by genus, the taxonomic level just above species.

Based on what grows in the petri plates and what they see on the slides, scientists can calculate how many spores (sometimes measured in colony forming units, or CFUs, because spores can travel in clumps) were present in a gram of dust from a home or in a cubic meter of air.

"I think a lot of people don't realize 1000 spores per cubic meter of air is normal," Muilenberg said. A cubic meter is about the size of a washing machine. An average breath takes in one liter of air.

"People might think that's a lot, but it's not, even for *Stachybotrys*. In outdoor air, it's not unusual to see 100,000 spores per cubic meter. You open a door, and thousands of spores come in, on your clothes, in your hair, on your shoes . . ." Every breath under those conditions takes in 100 spores.

Outdoors, spore counts are almost always higher, even if only slightly. Though typically in the tens of thousands, Muilenberg finds 100,000 to 150,000 spores per cubic meter outdoors in the peak season in the fall and after light rain, both of which promote spore formation.

The most common mold group found both indoors and outdoors is *Cladosporium*, which is followed closely by *Penicillium* and *Aspergillus* indoors, and mushroom spores outdoors. *Cladosporium*, *Penicillium*, and *Aspergillus* all contain dozens or hundreds of species, many or most of which could cause allergies, and some of which make mycotoxins.

There are so many spores in the air not because fungi are out to get us, but because fungi are doing what they've always done: silently, invisibly keep the world from being buried under dead leaves and junk mail. As handy as bacteria are with an enzyme in breaking down organic matter, they can't do it all. Dead plants and plant parts fall to the ground every day, and airborne spores settle on top to decompose them.

Mycologists have found they're especially good with cellulose, the main stuff of wood, leaves, fruit — and paper, cellulose ceiling tiles, and sheetrock liner. And doing that means reproducing at a pace that puts salmon to shame. Most spores will never land on a spot suitable for growth, so fungi maximize their chances by maximizing their output.

Fungi aren't only decayers. They are also surreptitiously growing in and around plants as parasites and partners. For every fungal plant disease, there are many fungi that live in and around plant roots helping the plant absorb water and minerals in exchange for food.

Fungi also make their way into the food we eat, sometimes unfortunately. A fungus called ergot can cause a disease called St. Anthony's Fire, which produces horrible gangrene, convulsions, burning sensations, and visual hallucinations. Victims consume the fungus in moldy wheat and rye, and unusually wet conditions in the 17th century may have contributed to the witch hunt hysteria of that century. One component of the toxic ergot mix was lysergic acid diethylamide — LSD. That discovery had consequences of its own for the 20th century.

Another fungus, *Aspergillus flavus*, produces aflatoxin — one of the most potent carcinogens known — on peanuts. Peanut companies are careful to screen their product and the government has set legal limits that no peanut butter is supposed to exceed, but if you ever find a black peanut, don't eat it, and don't give it to the dog, either.

Both these fungi make substances called mycotoxins. These are compounds that harm other organisms, and are generally produced when fungi are starving for nutrients, which is often.

Mycotoxins are well-known chemicals that have been studied for decades as causes of food poisoning. Some damage nerves, some cause kidney and liver damage, some are carcinogens, and others have hormonal effects.

One of the most devastating known case of fungal poisoning occurred during World War II, when thousands of Russians died from consuming a toxin that caused bleeding from the nose and mouth, vomiting, nausea, delirium, throat swelling, and opportunistic bacterial infections.

Years later, this disease — dubbed Alimentary Toxic Aleukia — was found to be the result of grain contaminated with mycotoxins made by a fungus called *Fusarium*. Because so many men were away fighting World War II, much of the wheat harvest remained in the field through the winter, allowing the fungus to grow. In the spring, the crop was full of mycotoxins called trichothecenes. Because the people were starving, they had no choice but to eat this grain.

Why do fungi produce toxins? They appear to play no direct role in mold metabolism. Rather, they seem, like the antibiotic-produced by *Penicillium* in Alexander Fleming's plate, to be a way for the mold to compete with other organisms for a piece of food.

Penicillin is, in fact, a mycotoxin. When competing with a mouse or a pig for a grain of corn or wheat, mycotoxins would give the mold the edge, particularly if the animals learn with the help of moldy smells or flavors to avoid eating mold-infested grain.

Many of the same fungi that make mycotoxins — *Aspergillus* and *Penicillium* in particular — are the same ones involved in making brie, roquefort cheese, and soy sauce. After extensive testing, scientists have established that while the fungi used to make these products *are* capable of producing toxins, they don't under the specific conditions involved in producing food.

So, as those concerned about toxic mold in the human environment claim, fungi are certainly capable of producing toxins. And these fungi sometimes grow in people's homes. Concern over these toxins has fed the explosion of mold claims; though not everyone has allergies or asthma, toxins, in theory, should be able to affect everyone. The question is whether they actually do.

TOMORROW: The evidence for health effects

Sidebar: Are modern homes moldier, and if so, why?

"Wood in the household may occasionally decay, but it is such a rare circumstance that the housewife pays little attention to it," said a 1903 book called *Bacteria, Yeasts, and Molds in the Home* a manual aimed at educating homemakers about domestic hygiene. Yet people commonly find mold growing on building material in homes today.

With all our advances in home building, how have we ended up with more mold in our homes now than 100 years ago?

Changes in the way our homes are built, scientists say, may inadvertently have made them more mold-friendly by increasing both the humidity and the food supply.

"Our buildings have changed a great deal in the past 30 years and we're starting to harvest the consequences of that," said David Miller a professor of biochemistry at Carleton University who specializes in fungal metabolites.

According to a 1999 book by environmental consultant David Hansen, the energy crisis of the 1970s brought profound changes to the way buildings were constructed. Buildings consume 60 percent of the electricity and 40 percent of the natural gas in the United States, and the biggest part of that expense is ventilation. This includes filling the building with fresh air, heating and cooling it, and running a fan system to keep air moving.

The first concern after the 1970s was to increase efficiency and reduce cost. Building managers shut outside dampers, reduced fan speeds, or turned them off completely. Buildings were “tightened” by increasing insulation, installing vapor barriers, and sealing major leakage areas like windows.

“We have tightened houses up a great deal to save energy,” Miller said. “When I was a child, energy was quite cheap, so it was affordable for my parents to pay the energy costs and let the building leak like a sieve.”

Less leakage meant more efficient heating and cooling and savings on fuel and energy, but it also meant the air circulating through a building became stale, with a greater potential for a buildup of contaminants of any sort. Soon occupants could no longer even open their windows. Indoor relative humidities were able to rise as never before.

A stronger dependence on air conditioning and heating to maintain the indoor environment also meant more miles of pipes and ductwork, and these pipes were in turn susceptible to mold growth from condensation. “I have never seen an air conditioning system that didn’t have a problem,” said Cambridge home inspector Jeff May.

What’s more, the heating and air conditioning ducts and filters were rarely or never serviced, allowing mold both a new niche in which to grow and a free pass to do it.

“I think there is a general decrease in attention to upkeep of buildings, not just school buildings but all the public buildings,” said toxicologist Bruce Jarvis, a professor of biochemistry at the University of Maryland. “There’s an increase in demand for public services, but without an increase in funds, you can’t do everything. Maintenance is one of the things that suffers.”

In homes, the situation has paralleled that of office buildings. Few people open their windows anymore, instead preferring to keep the house at a constant temperature year round. The average size of the American home has steadily increased, leading to an increase in the number of water pipes able to burst, heating and air conditioning vents, and crawl spaces in which mold can live.

And the number of building materials that can serve as mold food is growing, according to Miller. Wood is made of two main structural components — lignin and cellulose. Paper products are made only of cellulose. Lignin is highly resistant to decay, with only a few fungi capable of consuming it. Cellulose, on the other hand, is the white bread of the fungal world: easily digested and ubiquitous. Many, many fungi feed on it.

Modern homes are mold smorgasbords, because wallpaper, cellulose ceiling tiles, sheetrock liner, the paper covering on insulation and insulated pipes, organic debris in ducts, wood, and wood paneling are all potential mold foods. Mold can also grow inside portable air conditioning units, shower curtains, carpets, humidifiers and window caulking.

This hasn't always been the case.

"One hundred years ago, houses were built of plaster on wood and had no permanent carpets. Plaster, unlike paper, is made of lime and is resistant to fungal growth. If you wet traditional plaster, it gets more anti-fungal. If you wet wallboard, it grows mold because it's got paper on it," Miller said.

However, mold will never grow on these materials without one essential ingredient: water.

Burst pipes, slow leaks, and floods are typically the culprits, although condensation from faulty or poorly designed ductwork can also be to blame. And mold grows quickly. Lush growth takes only a few days.

Our homes may be more susceptible to water problems because of changing building practices, according to Miller. Early builders knew they could make a roof but couldn't seal windows very well, so they built eaves. Modern homes lack that protection.

"In the past 30-40 years, we've learned how to put caulking in windows and have taken the redundancy of rain protection away. The older engineers knew that a wall was going to leak eventually, so they always found a way to make sure that if it leaked, the water would go away," Miller said.

"So we've really changed the way we operate our houses and buildings, we've changed the way they're ventilated, we've changed how much dust accumulates in them, and this has really changed the exposure you get when you're a child," he added.

But others dispute the claim that a change in building practices is entirely responsible for the indoor mold explosion.

Bob Hartwig of the Insurance Information Institute explained: "In 1992, Florida had Hurricane Andrew. There were 200,000 water claims; 600,000 claims for houses that were damaged or destroyed. The houses were out wet, baking in the hot Florida sun for months, yet no one can remember a mold claim being filed. Yet somehow in 2000, without the benefit or a major hurricane that got everything all wet, we saw an explosion in these types of claims."

“The fact of the matter is that this litigation exploded almost overnight beginning in 2000. It wasn’t as if suddenly the entire housing stock of Texas on 1/1/2000 had been suddenly replaced with hermetically sealed buildings. That simply didn’t happen. So there was an explosion in this type of litigation beginning in 2000-2001 and you can’t attribute a growth rate of that size and magnitude to changes in construction techniques, because those changes in construction technique, technology and building materials don’t happen that quickly. But there was a virtual overnight explosion in this type of litigation, so it’s only a partial explanation.” Hartwig said.

Representatives of the housing industry agree.

“Many of the materials used in home building that are oftentimes considered “culprits” in mold growth have been used in homes for the past 50 years,” said Gerald M. Howard, CEO and executive vice president of the National Association of Home Builders, in his testimony to Congress. “Yet mold has only become an issue in the past 2-3 years. If the suggestion is that a ‘tighter’ home somehow increases the moisture build up in the home thereby leading to increased mold growth, then no, I do not believe that ‘tighter’ homes are the reason we have more mold claims today.”

III. A Hard Look at Mold and Health

Concern over mold in homes has grown in the last five years, and that concern has been fueled largely by fears of mycotoxins, toxic chemicals made by molds.

To many people, the object of greatest fear is *Stachybotrys*, the black fungus that has become synonymous in many minds with mold-induced doom. Upon finding *Stachybotrys* spores in their homes, many have considered that ample reason to move out.

It’s not hard to see why. In 1999, an article in *USA Weekend* called “Mold: A Health Alert” stated, “*Stachybotrys* is an especially lethal mold. It’s part of a family of molds that produce airborne toxins, called mycotoxins, that can cause serious breathing difficulties, memory and hearing loss, dizziness, flu-like symptoms, and bleeding in the lungs.”

An article in the *New York Times Magazine* called “Haunted By Mold” stated, “If you’re really unlucky, your toxic mold will gird for battle and go to war, secreting chemicals called mycotoxins, which can find their way into your body, entering through your nose, mouth and skin, lodging perhaps in your digestive tract, your lungs, or your brain.”

Yet the authors of a study in the Sept. 2003 *Current Allergy and Asthma Reports* had something different to say about mycotoxins. They wrote that while allergic responses to molds were common, reactions to inhaled toxins were rare. “Although mycotoxins and exposure to mycotoxins (“toxic mold syndrome”) are implicated in causing numerous, nonspecific, systemic symptoms, currently, there is no scientific evidence to support the allegation that human health is affected by inhaled mycotoxins,” the report said.

This contrast highlights the most conspicuous incongruity in the debate over molds and health: though the press and the public have focused on mycotoxins as the source of serious health problems, research shows that allergies and asthma are much more common.

This confusion is understandable. Until recently, very little research had looked into the effect of indoor mold on human health, and little monitoring was done.

“Other than surveillance for hospital-acquired [fungal] infections, there is no system to track the public’s exposure to and the possible health effects of mold,” said CDC scientist Stephen Redd, chief of the Air Pollution and Respiratory Health Branch of the National Center for Environmental Health, in a 2002 hearing before Congress.

As a result, homeowners, insurance companies, and lawyers have been left without a clear idea of the risks, leaving abundant room for argument — and emotion.

“It’s a spicy topic. People get in heated debates,” said Sam Lipson, director of the Environmental Health Unit for the Cambridge Department of Public Health.

This is not to say the health consequences of indoor molds are completely unknown.

There are four possible outcomes to mold exposure in homes, according to Alan Sugar, a physician and former director of the now-defunct Clinical Mycology Center at Boston Medical Center.

One possibility is that nothing happens at all. A second is an active infection where a fungus invades and grows inside a person — but this is rare because the responsible fungi are not normally found growing in indoor environments. A third possibility is an allergic response, typical of molds such as *Aspergillus* and *Cladosporium*. The final possibility is a direct effect from any toxins molds may produce.

There may be a fifth way molds can cause illness. According to Carleton University biochemistry professor David Miller, several recent studies have found an association between damp housing, indoor mold and respiratory illness.

“Mold indoors is associated with increases in upper respiratory disease, which means more colds and flus. That’s been demonstrated in infants, toddlers, and adults, and that is not an allergic disease. We’re sure that people who live and work in a moldy building have increases in respiratory disease,” said Miller. “This is a consensus by many scientists, not me. The mechanism is not known, but there is evidence.”

* * *

But public attention has focused not on increased respiratory disease, but potentially worse effects caused by mycotoxins. *Stachybotrys*, the black mold that has garnered most of the public’s attention, produces substances including trichothecenes, which in super-high doses are known to cause bleeding and suppress the immune system. Other species of indoor mold do as well.

So, do healthy people need to worry about the far smaller doses of airborne toxins they routinely encounter?

“I think, in general, no,” said Bruce Jarvis, a professor of biochemistry at the University of Maryland, who analyzes chemicals from mold contamination cases, detecting known toxins and identifying new ones. “Because most people apply common sense. You’re never going to get molds if you don’t have water problems, and most people recognize water problems and attend to them. There’s far too much attention paid to *Stachybotrys*, as if there’s something unique about it, and that’s not true.”

Penicillium and *Aspergillus* are much more common, Jarvis said. “There are hundreds of species within each genus. Most are not of concern, but a few are rather worrisome. But even within a species they are oftentimes idiosyncratic about what they produce. One produces a lot of toxin, another negligible amounts. Just because you find something in a building doesn’t necessarily mean it’s producing the toxins,” said Jarvis. “Amount is extremely important. Small amounts aren’t going to bother anyone to speak of.”

Mike Muilenberg, a research associate and instructor in the Department of Environmental Health at the Harvard School of Public Health, concurred. “We have a very rough idea of how much toxin is needed to cause an effect, and when you translate that into number of spores that someone would have to breathe in to get a similar dose, or even one tenth of that dose, or one hundredth of that dose, it’s a huge number and it’s not a number that people are exposed to in homes,” he said.

According to Sugar, mycotoxins can only be delivered by spores, but *Stachybotrys*, the arch-villain in most “toxic mold” scares, in particular, does not produce airborne spores unless disturbed. Even then, its spores tend to clump together in sticky masses and settle quickly from the air. So exposure to high concentrations of *Stachybotrys* toxins is not likely to occur, he said.

However, Jeff May, a Cambridge home inspector and author of the book *My House is Killing Me!*, points out that even if air concentrations are low, spores that settle on carpets could still be dangerous to young children, who spend a lot of their time on the floor and frequently put their hands in their mouths.

Many questions could be answered by a test that would measure a person’s exposure to mold toxins, thereby creating a way to verify that increased toxin exposure leads to worse symptoms. None exist.

“I think the principal thing that is missing in all of this is a reliable measure of exposure to these toxins that people are worried about. This is a difficult problem and one that brings about a lot of what I consider fraudulent information published in the literature and on the web about people’s exposure to toxins,” Jarvis said.

Recent reports from the scientific literature support these scientists’ claims.

A 2001 study in the *Annals of Allergy, Asthma, and Immunology* said, “There is a clear discrepancy today between the public perception and the current available scientific and clinical evidence concerning the toxic health effects of *Stachybotrys* . . . The current public concern for adverse health effects from inhalation of *Stachybotrys* spores in water-damaged buildings is not supported by published reports in the medical literature.”

Some lawyers, testers, and remediators have interpreted data from studies where animals ingested mycotoxins to argue that they could have the same effects if inhaled by humans. But medical researchers insist that to prove illness from inhalation, studies must be conducted via inhalation.

A 2002 review article in the *Journal of Asthma* said: “Although exposure to molds can produce significant mucosal irritation, there are very few data to suggest long-term ill effects. . . In fact, many of the data on toxigenic molds are derived from animal toxicity studies, and these are based primarily on ingestion.

“Although every attempt should be made to improve the quality of indoor air, including avoidance of molds, the human illnesses attributed to fungal exposure are, with the exception of invasive infections and mold allergy, relatively rare.”

* * *

In contrast, asthma and allergies are common effects of mold exposure. Allergies are overactive immune-system responses to environmental triggers, called allergens.

Allergy symptoms are well known now, thanks to direct-to-consumer drug advertising: stuffy or runny nose, sneezing, sinus pressure and chest pressure, wheezing, and red, itchy or watery eyes. When severely allergic people are constantly exposed to the offending allergens — whether molds or otherwise — it is a recipe for misery.

There are an estimated 40 million to 50 million Americans with allergies, according to the American Academy of Asthma, Allergy, and Immunology (AAAAI).

According to the American College of Occupational and Environmental Medicine, about 10 percent of the population (one quarter of those with allergies) have allergic antibodies to common molds, but only about 5 percent are predicted to suffer allergic symptoms as a result.

The ACOEM statement also notes, “It should be remembered that molds are not dominant allergens and that the outdoor molds, rather than indoor ones, are the most important.”

Molds can also induce asthma, a potentially fatal sudden constriction of the airways. The AAAAI estimates 10 million Americans suffer from allergic asthma, the type provoked by allergens such as mold. According to Miller, asthma has been associated with mold in buildings since 1698, when Sir John Floyer, considered the father of asthma research, discussed it extensively in a seminal textbook “A Treatise of the Asthma”.

According to a 2000 Institute of Medicine report, indoor mold is clearly associated with asthma symptoms, but scientists have yet to prove a cause-and-effect relationship. Nor are there yet conclusive studies showing that reducing indoor mold results in an abatement of symptoms.

But conclusive studies with potentially deadly substances are difficult and often unethical to perform on humans. “We don’t test humans against toxins or presence of something that might be dangerous. We do things by association. You’ve got to prove something scientifically, and that’s a hard thing to do here,” said mycologist Berlin Nelson of the University of Nebraska.

At least one family is seeking to show mold caused the asthma attack that killed their 7-year-old child, Massachusetts attorney Clyde Bergstresser said. The child lived in housing on property owned by the Massachusetts Institute of Technology, and the university is named as a defendant in the suit.

“The death case is not one where the science is in question,” Bergstresser said. “It’s been around a long time where people can have asthma to cats so on and if they’re around it long enough, they’ll die.”

Testing presents a difficulty for those who hope to show mold allergies are the cause of their health woes: though there are thousands of species of indoor mold, only 2 or 3 are tested for in most skin-prick tests by allergists, according to the Institute of Medicine. However, according to a 1998 California study, nine different fungal extracts were necessary to detect most mold allergies.

Compounding the problem, a single species of fungus may produce dozens of allergens, any of which may be the source of an allergy, but only one or a few of them may be included in a single allergy test for a mold. If the allergen(s) causing an allergy are not in the battery of tests, someone who is genuinely allergic to mold may be told they are not.

Moreover, there is no standardized set of fungal test allergens, according to the IOM report. Nor do standards exist for how extracts are made, and they therefore vary in potency lab-by-lab.

As a result, the true prevalence of fungus-induced asthma and allergies is unknown, and may be greatly underestimated.

People suffering from mold allergies may be frustrated by another problem: while they are devastated by mold allergens, others living and working with them may suffer no ill effects, and even accuse them of making up their symptoms.

“Seventy-five percent of people may have no problem with mold at all, but 25 percent have problems. And the 75 percent will think the 25 percent are crazy,” May said.

Homes are also full of potential allergy-causing substances, which can make it difficult to prove that molds are the particular cause of any allergy sufferer's misery.

"House dust is not a single antigen, but a complex mixture of potentially allergenic biologic materials, including human and animal hair and dander, mites, molds, textiles, food leftovers, bacteria, insect parts, and decomposed material," wrote physicians David Weissman and Mark Schuyler in the handbook *Indoor Air Pollution*.

Since those allergic to molds tend to have allergies to many other substances as well, it is very difficult to determine what is causing their symptoms at any given time, a problem that dogs those seeking to prove mold caused their allergies or asthma in court.

* * *

Some indoor mold cases, however, may be tied in to a larger phenomenon, one where physical symptoms may actually have a psychological origin. But they are mixed in with legitimate cases, and extremely difficult to sort out because of confusion over mold and health.

Barry Beyerstein, a psychopharmacologist at Simon Fraser University who specializes in mass hysteria, pseudoscience, and psychosomatic illnesses and is also on the board of editors at *The Skeptical Inquirer*, pointed to a book called *From Paralysis to Fatigue* by Edward Shorter to illustrate this point.

"Shorter points out that the symptom pool for sick building syndrome, chronic fatigue syndrome, breast implants, gulf war syndrome, and mass hysteria, are all very similar kinds of things," he said. "He traces it back and finds that at different times it's been called different things — hysteria, fibromyalgia, the vapors. He's saying that what this is called and what it's attributed to has varied, but the symptom pool has remained remarkably similar, except for cases where a new diagnostic tool comes out that shows a pathology, and as soon as that happens, those symptoms drop out of the symptom pool. Aches, pains, memory problems, and headaches remain remarkably constant over history. He argues these are probably expressions of psychosocial symptoms manifested as physical problems."

"We shouldn't minimize the fact that those affected aren't faking it and it really is messing up their lives. But we should ask what is the real cause of those symptoms. It goes back to the undesirability of accepting that these are psychological symptoms."

Mold is a currently convenient diagnosis for any unexplained illness.

“A lot of it’s heightened awareness of mold and it’s just a ready explanation for a lot of the things that go on in people’s bodies,” Sugar said. “Mold is an easy target because eventually you can see it and people in the lay press have gotten hold of the information and people are attuned to this. They smell musty smells, and whatever’s going on in with them in terms of symptoms must be due to the mold.”

The special psychology of mold may also have created the environment in which mold litigation could thrive.

“When it comes to health, people want a digital world where everything is one way or the other,” said Jarvis. “They don’t want a gray answer — they want a definite problem they can get rid of. It just gives all sorts of opportunities for people to distort the system. That happens on both sides — positive and negative. They don’t want to hear ‘We don’t really know.’ It doesn’t matter whether it’s flu or cancer.”

Mold lawyer Raymund King has found many of his recent clients are women being treated for bipolar disorder or depression who truly believe themselves injured by mold. But King doubts their cases can be proved, and suspects them to be malingerers who crave diagnoses.

“Unfortunately, a lot of malingerers don’t know they’re malingering. They get some kind of secondary gain or benefit in the treatment or attention, or they get relief in knowing ‘Oh, I have a diagnosis.’ When in fact, medically, they’re ok.”

Even for non-malingerers, the power of the mind can have profound effects. One intriguing phenomenon called the nocebo effect may exert its power over those who find mold in their homes. This effect occurs when people consume an inert substance such as water, are then told it’s harmful, and subsequently develop physical illness. “Who’s to say for someone believing that the black spot they see on the wall is causing their migraine headache, that that perception is not really doing that?” said King.

In his book *Toxic Mold Litigation*, King points to the problem with any substance which can be labeled a toxin: “The general public readily accepts the notion that a specific agent is the sole cause of all their symptoms or illnesses if that agent definitively produces any level of toxin, despite statistical improbability.”

* * *

There is, of course, still more to be learned. One thing that's missing, according to Muilenberg, is long-term data.

"I do think the toxin issue needs to be looked at more closely. What are the long term effects of low exposures?" he said.

Still, scientists seem surprised by how far the mold scare has gone.

"I'm not strongly on one side or the other [of the debate]," Jarvis said. "I think overall mold does contribute to the risk of human health, but I think there are so many cases that are blown way out of proportion."

"What's surprised me the most has been the reaction and the perceptions about the mycotoxins and exposure," Muilenberg said. "And without the science behind it, that something can gain that much momentum. And I guess I shouldn't be surprised, I guess that's naive, because it happens in many other fields as well."

TOMORROW: Profiteering from mold fever

Sidebar: Another way to suffer from molds

Allergies are not the only way in which molds can upset immune systems.

Hypersensitivity pneumonitis (HP) is an immune response gone wrong that can be triggered by fungi. Sudden onset of fever, chills, shortness of breath and pneumonia-like symptoms are the hallmarks of HP.

HP has been documented primarily in workers exposed to massive quantities of fungus-laced dust or moldy substances. Farmers exposed to large amounts of moldy hay may exhibit a form of HP known as farmer's lung. Other examples have been dubbed cheese worker's lung, peat moss processors lung, basement shower HP, saxophonist's lung (triggered by moldy reeds), and maple bark stripper disease, according to a 1997 report in the *Annals of Allergy, Asthma, and Immunology*.

HP is also linked also to syndromes called humidifier lung or humidifier fever. Humidifiers and other air modification devices in heating and cooling systems typically use baffle plates to aid in adjusting the air moisture content.

Because the air is filled with organisms that lack only water to spring to life, baffle plates are soon colonized by bacteria, protozoa (single-celled organisms), fungus-like bacteria called actinomycetes, and fungi. The resulting “baffle plate slime” can cause hypersensitivity pneumonitis if aerosolized.

IV. Mold Profiteering

A mix of absent government standards, alarming media reports, and misunderstanding of mold has created ideal conditions for unscrupulous remediators, lawyers, and home inspectors to profit from people concerned and confused about mold in their homes.

“There is so much misunderstanding of mold because it’s been perverted by the media — and I’m sorry to say — litigation,” said Texas attorney Raymund King, author of *Toxic Mold Litigation*.

The problem is that some molds do sometimes have health effects, sometimes serious; but not in everyone, and not all the time. This lack of consistency has created understandable confusion, making it sometimes difficult for those with legitimate mold-related problems to receive assistance and easy for others to exploit those who don’t.

At 2002 Congressional Hearings called “Mold: A Growing Problem”, Representative Sue Kelly (R-N.Y.) said, “The uncertainty of this issue has created a window of opportunity for unethical lawyers and contractors to prey upon vulnerable populations.”

But the profit-making begins even before a homeowner might seek legal assistance or remediation. As awareness of mold problems has increased, so has demand for mold testing and information. Enterprising businesses have been happy to oblige in providing products and services to meet this demand.

Do-it-yourself mold testing kits have turned up in home improvement stores, and titles such as “What Every Home Owner Needs to Know About Mold (And What to Do About It)” have been published with the anxious homeowner in mind. A variety of private testing labs provide in-home mold testing, and even mold-sniffing dogs are available to those who find their own sniffers insufficient.

And on the internet, ads proliferate. “Do you have black mold? Easy do-it-yourself kit tests for toxic mold. From \$7.95” or “24-hour response toxic mold testing lab”.

One newspaper ad reads: “MOLD??? ODORS?? ALLERGIES?? Crawl Space Environmental Specialists [phone number] CALL *AMERICRAWL* NATIONWIDE”

Another website says, “The only way to be sure whether you have a mold problem is to test your environment. Testing for mold is easy when you use one of our Home Mold Test Kits.”

The problem is that it is very unclear, what, if anything, such testing shows. There are no regulations and little science to say which species are dangerous and which are not, and what level of mold constitutes a problem. Does “mold positive” mean anything when molds are a normal part of indoor air?

“People begin to look around at their own situation, and they find mold, which is in lots and lots of buildings and always has been,” said John Haines, an emeritus mycologist at the New York State Museum in Albany.

The problem is complicated by the lack of any standards. “There’s no standard to say what an abnormally high mold level is and in fact it varies from season to season, it varies from day to day depending on how much wind there is,” said physician Alan Sugar, former director of the now-defunct Clinical Mycology Center at Boston Medical Center.

Interpreting results is also complicated by factors such as the relative humidity and whether windows and doors are open. And indoor levels are almost meaningless without knowledge of the levels outdoors.

“All these values have to be compared from indoors to outdoors. It’s very difficult to make any sense out of isolated mold levels that are typically done by people when they’re worried about mold in their house,” he said.

The quality of professional testing also varies widely.

“There’s a huge amount of incompetence out there,” said Jeffrey May, a Cambridge home inspector and author of the book *My House is Killing Me!*. “There’s only a handful of people in the world that actually do the investigations and take the samples themselves and look at the samples under the microscope.”

May personally inspects and collects samples from the homes he is evaluating, and estimates he has collected 16,000 samples.

He finds that most industry sampling and identification are poorly executed by staff with little training. Misidentification of one mold for another is very common, he said. Some misidentifications are even more basic. In one home, the testing lab identified microscopic spray

paint droplets as mold. “The remediator was called back three times to redo a basement because of a mold problem that was spray paint spheres,” May said.

In another home, a woman even wanted to believe she had an infamous mold called *Stachybotrys* when she did not. Since she had two children with asthma, and after a testing lab had informed her she had *Stachybotrys*, they told her to move out. She had been living in a trailer in the driveway for two weeks when a TV station called May out to look at her home. Her ceilings were blackened, supposedly by toxic mold, but he found that it was candle soot.

May believes another large problem is inadequate sampling. “People don’t take enough samples when there are problems. So I don’t stop till I find the problem. I take maybe 20 or 30 samples, given the situation,” he said.

Sloppy testing is only part of the larger mold problem. Unscrupulous remediators have thrived in the environment created by panic over mold.

According to King, exploitation is rampant. “Mold remediation is probably one of the most highly abused aspects of mold litigation right now. I’ve run across a number of cases where sometimes the cost of the remediation exceeds, doubles or even triples the property value, which is ridiculous, because what’s happening is that a number of the remediators were yesteryear’s plumbers and painters. All of a sudden, they’re “certified” in remediation, when in fact, there are a lot of so-called certifications that amount to two people shaking hands and certifying each other. That’s one aspect of it, but that’s only the tip of the iceberg,” he said.

He places the blame with paranoid insurance companies.

“When the Ballard case came out in Texas, the insurance company was initially hit for \$32 million, I believe that insurance companies got scared and they chose to err on the side of over caution. Anytime anybody had a mold claim, they would pull out all the guns. ‘Let’s hire the best remediator, the most expensive remediator’. Or ‘Let’s hire someone who remediates the heck out of the property’. And that made the ground fertile for this cottage industry in remediators.”

One man, according to King, who reported mold to his insurance company was asked to vacate the premises. His furniture was stacked in the kitchen, and the remediators gutted his house over the course of a year and a half, during which he lived at a hotel. At the end of his insurance term, the company dropped him.

“No one would insure him because he had a prior mold claim. And now here he is with property which is worthless, though it’s in a really nice neighborhood, but no one’s going to buy it, no one’s going to insure it, so what does he do?” King said.

* * *

Lawyers have also profited from fears over mold. At the 2002 Congressional hearing, Representative Gary Miller (R-Calif.) told the Committee, “I read a speech given at a gathering of attorneys, and the new quote is “mold is gold”.

But others disagree that mold litigation is being driven by lawyers. “There isn’t much money in mold cases — very little has been made thus far,” said David Yas, editor-in-chief of *Massachusetts Lawyers Weekly*. “It’s such a hard thing to prove, it’s not a jackpot kind of case. The insurance industry and others are quick to blame new niches in the law on entrepreneurial lawyers, but it just doesn’t work that way. The fact of the matter is that you still have to prove it in court.”

“It’s kind of bootstrapping to say any source of claims are being driven by trial lawyers,” said Massachusetts attorney Clyde Bergstresser. “All claims are driven by trial lawyers. If a lawyer has any sense of survivability they’re only going to file claims they think they can recover. Are trial lawyers going out and creating new claims? No. Are people more conscious, including trial lawyers? Sure.”

But scientists say that sometimes, the tactics lawyers use to prove their cases in court pervert the science.

“When lawyers get involved, they have a different agenda where science takes a second seat. I feel sorry for the people and juries involved,” said Bruce Jarvis, a professor of biochemistry at the University of Maryland who studies mold toxins.

He has been called to testify in a number of court cases where individuals have used fraudulent information about such toxins to lure clients.

“I want to emphasize how dangerous these reports are to people who have legitimate health problems,” Jarvis said. “They are told by these people that they have toxins coursing through their system. One, it scares the hell out of them. And two, they may have a legitimate case. As soon as you bring in this bogus person, it poisons their case. As soon as you bring in

someone like me on the other side, it destroys their case, which may in fact have some legitimacy to it.”

John Haines, an emeritus mycologist at the New York State Museum in Albany agreed. “I do know that there is an immense amount of money involved in the lawsuits over mold and I think that has skewed or twisted the science.”

But King lays the blame not just on lawyers, but also on unscrupulous experts that they sometimes hire. “There are some plaintiff’s experts out there that make a lot of money. I’ve run across experts that charge anywhere from \$400 to \$1500 an hour. It’s quite a racket. And all they have to say is, ‘Yes, I’m board certified, and yes, I’m credentialed, and oh yes, in all medical probability, this caused this. Where’s my money?’”

In other cases, lawsuits have been brought against insurance companies with dubious scientific backing, according to King.

One family brought a case against an insurance company claiming that mold caused their child to be stillborn. Lung cancer victims who’ve only lived in their homes for six months or a year, have claimed that mold caused their cancer, despite the fact they’ve been smoking for years.

“This happens all the time,” said King. What they and their lawyers fail to realize is that it takes much longer than six months for the mutations that cause cancer to accumulate, he said.

Mold fever has also begun to penetrate the corporate world as well. The targets of claims are increasingly businesses including hotels, office buildings, the contractors who construct them, and even the architects who design them, who can be sued for “negligent” designs, said Bob Hartwig chief economist of the Insurance Information Institute. As a result, premiums for construction companies and architects are rising.

Even the perception of mold problems can cause trouble.

“Some of the most recent trends that have gotten a lot of publicity are hotels that have closed down because of mold, not necessarily because mold was rampant, but because no one wanted to go to the hotel anymore,” said mold lawyer King.

Hilton Hotels Corporation, for example, was forced to close the one-year-old Kalia Tower of its Hilton Hawaiian Village Hotel for a year because of mold problems in guest rooms and its spa and fitness center. Hilton sued the designers, engineering consultants, and subcontractors.

“The new theories I’m seeing are, “Well, we can’t prove that the mold causes ill effects, but the publicity from the ill effects is such that it has diminished the property value to the point that you owe me a lot of money now, because of your negligent design or because of your negligent construction of the structure, or your negligent you-name-it,” King said.

Ray Petrisek, director of environmental microbiology at HP Environmental, the firm that helped clean up the World Trade Center in 1993 and again after September 11, said, “I’m doing a few cases that are so ridiculous that it’s almost a laugh that I have to be involved. But again, when you’re an insurance company, and you’re on the line for \$250 million dollars on something that you insured, you have to put up the proper components, the consultants, the engineers, and the scientists to substantiate that the litigation is either truly a liability of theirs or not. That’s where all this has gotten really out of hand.”

* * *

At the heart of all these troubles is a lack of any state or national standards or regulations regarding mold.

The problem is that mold, unlike carbon monoxide or lead, for example, affects everyone differently — or not at all, according to assistant commissioner Suzanne Condon of the Massachusetts Department of Public Health. There is no set cutoff beyond which everyone will encounter serious consequences, as with the buildup of radon or carbon monoxide gas. And there are thousands of different species of mold, the majority of which do not cause problems in humans.

Condon steers those who ask her advice away from testing. “Testing to see how much is there, since there really are no standards or guidelines for mold exposure, doesn’t really tell you a lot. We tell people if you’re going to invest money, invest it in fixing the problem and getting rid of the mold,” she said. “If you can smell it, you know it’s there. Fix the leak, then use a disinfectant for non-porous items and toss porous stuff.”

Trying to create uniform standards for a group of thousands of living organisms with erratic life cycles has stymied lawmakers trying to draft or pass mold legislation. Mold levels in indoor and outdoor air change from day to day and season to season. “Can you really change standards based on season?” Condon asked. “That’s kind of a tough way to regulate.”

Condon suggests the solution may be to develop a standard that says indoor mold levels must be no more than 10 percent above outdoor conditions.

“You’re never going to be able to assign a number to it because what a number means in September is entirely different than what it means in May,” she said.

As a result of these difficulties, very few states have passed mold regulations. Texas has taken the lead by passing a law in June 2003 requiring mold inspectors, testers, and remediators to become licensed. In Massachusetts, Senator Robert O’Leary has introduced a bill in the state legislature to study the effects of toxic mold.

But in most states, the legislatures are paralyzed, according to King, because the insurance companies, remediators, or plaintiff’s lawyers have strong lobbies that prevent passage of mold legislation.

For Nancy Davis, a resident of Pepperell, Massachusetts, who had to abandon her home because of a mold infestation, guidelines are only the first step. She would like to see regulation of home inspectors as well. Though her home was inspected prior to sale, the inspection turned up no evidence of mold, though there were massive quantities growing in the attic.

“A realtor should not be allowed to recommend a home inspector. That sets up a chain of events that can really, really hurt a person. The buyer should find their own inspector or they should be given a list of 30 different places and they should pick their own. When a realtor is hooked up with a home inspector, their job is to sell the house. There’s a conflict of interest. But it’s done every single day.”

Federal legislation would seem like the ideal solution, and a bill was even drafted to address the problem — the U.S. Toxic Mold Protection Act, also called the Melina Bill, after the daughter of Michigan Representative John Conyers. She began suffering attacks after moving into a new house in 2002 that led her to lose 70 percent of her lung capacity.

The bill provided for a joint study on the toxic effects of indoor mold by the CDC, National Institutes of Health and Environmental Protection Agency and subsequent national standards on mold inspection, remediation, testing, and education. But it has floundered in Congress.

“Everything has taken a back seat to other issues like the war,” King said. “There’s so many issues out there right now that, really mold is the least of their concerns.” He believes that

it will not be until the mold problem starts to injure the insurance industry, the plaintiff's attorneys, or someone with a big lobby that something gets done.

This lack of standards makes it very difficult for scientists and government officials to provide good advice. "There's a lot of concern among homeowners, and a lot of people call me about these issues," Nelson said, "and to tell you the truth, it's really hard to give these people good information because of the lack of guidelines. It's tough for the homeowner or the business owner to know what to do, and it's so expensive to hire a consultant to make recommendations."

Worse still, there is uncertainty even as to what the best way to clean a moderate mold problem is. To bleach or not to bleach? Hard to know. On their websites, the CDC recommends it, while the EPA does not.

According to an EPA statement on biocontaminant control on their website, "There is significant uncertainty about the soundness of the basic principles used by some of the [mold] control techniques. A lack of scientific data plus the lack of standard testing methods make it almost impossible to evaluate the effectiveness of various prevention, cleaning, and mitigation techniques sold in the marketplace."

The EPA is currently conducting research to help resolve these questions.

A report from the prestigious Institute of Medicine called "Damp Indoor Spaces and Health" was expected to address this issue last summer or fall; it is now scheduled for release in June 2004. Many in the mold wars hope that this report will provide the guidance needed to create sound mold guidelines and delineate health risks.

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