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Two fungi, *Cryptococcous neoformans* and *Histoplasma capsulatum*, which are pathogenic to some animals and humans, are found in association with the habitats of birds. This association will be discussed by a review *of Cryptococcosis and C. neoformans* in association with pigeons and their habitats, reviewing histoplasmosis and relating the experience of the Soil Ecology Unit Mycoses Section in Kansas City with *H. capsulatum* associated with blackbird and starling roosts during the past nine months of this year.

Cryptococcosis

Cryptococcosis is a disease of urban areas, usually associated with the respiratory intake of the yeast-like fungus. This disease usually begins as a primary infection of the lungs in which it is asymptomatic in about one-third of the cases. When the involvement becomes apparent, the symptoms are cough, chest pain, mucoid sputum production, weight loss, and low grade fever. The disease may be disseminated by the blood system, invade the central nervous system and produce symptoms characteristic of meningitis such as headache, becoming progressively more severe, associated with nausea, vomiting, and vertigo. These symptoms usually last for six months with death resulting in untreated cases. Treatment for both primary and central nervous system cryptococcosis is the intravenous administration of the antibiotic amphoter-icin-B.

The organism *Cryptococcous neoformans* is found world wide. It has been repeatedly isolated from pigeon manure and their nests and less often isolated from other avian manure and soil. As yet there has not been a definite association of this disease with pigeon habitats except in retrospect, but in studies conducted in pigeons handlers using a cryptococcal skin test antigen it was found that the handlers had a higher dermal reaction to the antigen than nonhandlers. The relationship of the organism to the pigeon is not a direct one, since natural cryptococcal infections in pigeons have not been demonstrated. But it has been shown that the birds are moderately susceptible to experimental infections by injection through an intercerebral route. It was long suggested that the high body temperature of birds, (41.5=43.3°) was above that which can be tolerated by the organism. In experiments with feeding viable organisms to birds it has been found that *C. neofromans* will survive in the guts of pigeons and canaries and would appear in fresh manure. *C. neoformans* remains viable in nature for prolonged period of time. It had been isolated

regularly over a three-year period from sidewalk sweepings from a building in Wisconsin, and it will survive for over two years in desiccated pigeon manure.

Emmons has reported that fifty million viable cells were contained in each gram of manure taken from a sidewalk in Washington, D.C. Although the fungus is readily found in nature, the factors which stimulate its growth are not yet fully understood. Studies have demonstrated that pigeon manure by its chemical composition serves as an enriched medium, especially by providing creatinine. This chemical is utilized but not required by only *C. neoformans*, and not by other species of yeast or yeast-like organisms. Studies have also indicated that the increase of pH towards 12 of the pigeon manure by bacteria inhibits the organism's growth. Under natural conditions, however, this does not seem to exert much influence on the recovery of the organism.

Although cryptococcosis is relatively uncommon, the severity of the disease in causing death and damage to the central nervous system and long hospitalization for treatment dictates a need for controlling the disease. The most direct method would be to reduce and control the size of wild pigeon flocks to such a degree that contaminated pigeon manure would not be a factor in the disease. There are methods for controlling the contaminated pigeon manure by altering the pH of the manure itself, or the organism may be eliminated from the manure by the application of a saponated cresol compound.

Histoplasmosis.

Histoplasmosis is a disease associated with the inhalation of spores of the fungus. The disease is primarily a respiratory infection of three clinical types progressing in this order: (1), acute pulmonary histoplasmosis in which the cases have symptoms of a flu-life illness with chills, fever, and a relatively more productive cough, the symptoms lasting a few days in mild cases to several weeks in more severe cases; (2), chronic cavitary histoplasmosis in which the disease is chronic with a cough, puritic sputum production, weight loss, weakness and fatigue. This type of disease is indistinguishable from pulmonary tuberculosis and becomes more serious if not treated; (3), disseminated histoplasmosis. Here the disease is spread throughout the body by the blood system. It is characterized by a high fever, weight loss, enlarged liver and spleen, and ulcerative lesions of the mucous membrane. Patients with disseminated disease may survive for several years but usually succumb to the disease if left untreated.

The organism *Histoplasma capsulatum* is found world wide in soil which has become contaminated by avian manure, especially that of chickens, grackles, red-winged blackbirds, and starlings. The fungus has also been recovered from attics and caves inhabited by bats. The birds themselves are not infected with the fungus nor do they appear to be the mechanical carriers of the organism. Bats are infected, though, and they excrete the organisms in their feces. *H. capsulatum* remains viable for long periods of time after the birds have been removed from the area. Our laboratory has been able to isolate the organism yearly from the same farm in Iowa for the past eighteen years, and the birds have been absent during this period. As high as two hundred thousand viable *H. capsulatum* particles have been estimated per gram

of soil from a blackbird roost by an experimental quantitative method. The organism has been eliminated from an epidemic foci by the use of two chemicals: 3% formalin solution and pentachlorphenol suspended in fuel oil, the formalin solution being more practical because it comes closer to meeting the requirements of the ideal decontamination agent.

The Soil Unit of the Kansas City Laboratory has during the past nine months been active in processing soil samples from blackbird and starling roosts for the isolation of *H. capsulatum.* We have collected and/or processed samples from eighteen roosts located in the middle United States. *H. capsulatum* has been isolated from eight roosts. Samples from one roost are still pending, but that roost is suspected of being the source of infection of three construction workers who had worked on the site.

We have found positive roosts in Ohio at Delaware, Springfield, London, and the airport at Columbus; Glendale, Indiana; Morristown, Tennessee; Topeka, Kansas; and at Lee's Summit and Springfield, Missouri. Springfield, Missouri is the one roost from which we haven't completed the soil samples.

Several of these roosts have been responsible for human histoplasmosis or have prompted control measures to prevent infection. At Lee's Summit, Missouri, a half-acre site which has been used by birds for a period of about four years resulted in complaints to the city and state health officials from the surrounding population of the odor and bird noise. Our laboratory was requested to sample the area and *H. capsulatum* was isolated from several of the samples. Upon notification that the roost was positive for the organism, the city posted the area with signs warning of the danger of infection. They have also refused the owner permission to construct an apartment complex on the site until the organism was eliminated. The birds were removed from the roost, by the use of scare devices.

A similar series of events happened in Topeka, Kansas: complaints about the birds and collection of soil samples which resulted in positive *H. capsulatum* cultures. On this site of about four acres, the city decided to decontaminate the area with formalin. First they erected signs warning the general population that the area was contaminated. This did not prevent the surrounding people from going into the area; it warned the people that a danger existed. Since the area was so dense, roads had to be cut into the birds roosts in order to lay the hoses needed to completely cover the far reaches of the roost. This operation was carried out using a 1500 gallon tank filled with formalin and the water pumped through the fire hose by a pressure system on the truck. Since we're interested in decontamination, we are following and processing soil samples from a standard sampling area every three months, six months, and then a year after decontamination.

On Earth Day last April at the Frank B. Willis Junior High School in Delaware, Ohio, the children decided that a good project would be to clean up the city parks and school grounds of all kinds of trash. This was approved by the school, and they accomplished this the last weeks of April.

At the school there was a courtyard which was completely enclosed by the school building and was unused. The courtyard had become a trash collection point from the kids throwing stuff out of the school windows. This area was also included in their clean up activities. In cleaning the courtyard a large amount of dust was generated which was drawn into the school by ventilators. About 14 days later

there were many absences due to a respiratory illness in the school, totaling eventually about 250 school children and a third of the faculty. The illness was tentatively diagnosed as histoplasmosis. With this diagnosis, soil samples were collected throughout Delaware, at the school grounds, this courtyard, and the parks. *H. capsulatrum* was isolated only from this courtyard from four separate samples. The school officials disclaimed any knowledge of birds ever having been in this place at the time. In talking with them again, some of the teachers said that birds had roosted in there several years before, but none for the last three or four years. To prevent further infection in the school population, the school board decided to decontaminate the area using 3% formalin.

One of the most interesting histoplasmosis bird roost associations occurred in Springfield, Missouri,. Here, in a roost of about 20 acres, there bulldozer operators, while cleaning the roost of trees, became ill. The illness was diagnosed as histoplasmosis. This diagnosis is not itself unique except that the workers were life-long residents of this area and should have been infected with the organism before they were graduated from high school; 73-78% of the residents have been so infected. What is unique is that these men could well have been reinfected with *H. capsulatum* by inhaling an over-whelming dose of the organism, this casting doubt on the popular theroy that once infected and recovered from the disease a person has life-long immunity. All three of the workers have now recovered and are back at work. One other case of histo has been diagnosed from this roost from a ten-year-old boy who built a tree house there.

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DISCUSSION:

DELEGATE: Did you till the soil in any of these places? How deep do you think you soaked the soil?

R. WEEKS: I know that we penetrated more than four inches with the formalin. This we have done on a lot of experimental work with colorimetric methods and so forth.

DELEGATE: Is that far enough?

R. WEEKS: Most fungi really grow in the first three inches of soil, and this is true of histo. We seldom find histo below four inches on a depth sample.

W. JACKSON: Were the trees killed by the formalin?

R. WEEKS: No, a tree and any deep rooted bushes go down five or six feet below the ground, and they are not affected unless you spray the leaves. If you spray the leaves early in the Spring, then they shouldn't have any problems at all-they will releaf.

K. SMITH: I understand that this disease is common to the Midwest and has been found in central Ohio. How about further areas east?

R. WEEKS: Well, In Ohio the skin sensitivity test is rather high. I don't know the figures exactly, but they are something like 60%. This is all based on Navy recruits that are 18 years old that came through the Great Lakes Naval Training Center. These tests are related back to the county of residence, and we have sensitivity rates in percentages for all the counties in the United States. Just right off hand it is about 60% in Delaware county, and it is probably true for a good portion of Ohio except maybe up around the lakes or on further east.

R. SMITH: Is this related to weather or why not further east? You certainly have the birds and roosts.

R. WEEKS: In all probably because people haven't done any work over there.

DELEGATE: There was someone who spoke on histo in Kansas City, and he told about contamination along the east coast up some of the rivers. Is there any on the west coast?

R. WEEKS: No, but they have a problem with coccidioidomycosis. This isn't in association with birds, unfortunately, but it has some association with the rat and other rodent burrows.

DELEGATE: Are there any records of histoplasmosis at farm-feed lots and pastures where there are lots of grackles and cow birds?

R. WEEKS: No. This gets into some other work which we have done with blackbird roosts in Missouri and Arkansas. We found that the histo was only isolated from roosts that were three or more years old. These are roosts and not feeding areas. This is where you get the manure build up.

DELEGATE: From the service technician's point of view, after the birds have been eliminated around a roost, we're often called to eliminate ectoparasites in lofts and belltowers. The technicians have to lift up trap doors where there might be twelve inches of pigeon manure, and they hesitate to go in there. What suggestion and what advice can you give to an operator who has to send a technician into this area?

R. WEEKS: This is an area we haven't really gotten too far into yet. We know the habitat from which we can isolate the cryptococcal organisms. We don't know the

incubation period. We know the size of the organism is quite large, but we don't know if one organism will infect an individual. There is not an effective skin test antigen to determine whether you have had the disease or not. Probably the best method would be an attempt to isolate the organism from the manure before you send a man in there. If you isolated the organism, then it would be best to decontaminate it in some way.