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Check List of Fungi isolated from polluted Water and Sewage.

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From the beginning of life, various members of the populations of the world have been leaving their bodies or the remains of their metabolic processes on the land or in the water to continue the process of decay. The organic materials of which they were composed may be used and reused. One type of organism in the waters of the world, aiding in this decomposition, is the group commonly called "sewage fungus" (Cooke, 1954 a). These organisms have developed a specialized type of metabolism in which certain forms of carbon and nitrogen compounds can be utilized but not others. As the numbers of man increased, and as his physical requirements increased, the waters of the world have increasingly carried the waste products resulting from this development, and organisms adapted to the special nutrients found therein have thrived and multiplied. In this way, we may suppose, such organisms as the filamentous bacterium *Sphaerotilus natans* and the water mold *Leptomitus lacteus* have developed, multiplied, and filled their special ecological niches. *Leptomitus* has developed to the point that it uses fatty acids rather than sugars, and amino acids rather than ammonia (Cantino, 1955).

The principal source of pollution in the habitats which were surveyed resulting in the following list was fecal material and other household wastes such as ground garbage. Such materials are high in organic matter content and may furnish large amounts of foods to fungi that have become adapted in one way or another from life in the soil to life in the water or in the stream bed. Under restricted conditions, with certain carbohydrate, nitrogenous, and as yet undetermined additives, and under certain conditions of substrate and bottom materials resulting in special pH and mineral content conditions, certain Saprolegniaceae, *Leptomitus lacteus,* and various soil fungi such as *Fusarium aquaeductuum, Geotrichum candidum, Penicillium lilacinum,* and others may thrive.

In the forest or the pasture, fungi growing on the dung of animals are referred to as "coprophilus" fungi. Three types of fungi which may be put in this physiological class have been found in sewage

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polluted water and on trickling filters. A species of *Pilobolus* (Harvey, 1952) was found at one station on Lytle Creek by use of hemp seed as an isolating medium. It was found again on the Glendale, Ohio, trickling filter. Intensive biochemical studies (Hesseltine, et al., 1953) have shown that this fungus can be propagated in the laboratory without ingestion and alimentation by an animal. *Ascodesmis microscopica* was found once in 1955 on a trickling filter at Dayton, Ohio. While these two fungi have been found elsewhere, *Subbaromyces splendens* Hesseltine, has only been found on trickling filters, first at Pearl River, New York, then at Pullman, Washington, and finally commonly in the Dayton, Ohio, sewage treatment plant.

An organism can become adapted to one set of conditions or another. In some cases the adaptation may be complete, so that the organism cannot tolerate any other conditions, but more often various degrees of adaptation may be attained by an organism. Moser (1949), studying the adaptation of certain fungi, mosses, and seed plants to areas in the Tyrolean forests which had been burned by fires ranging from large forest fires to small camp fires, developed a set of terms to describe the degree of adaptation of these organisms to burned areas. The suffixes he used can be applied to other prefix or root terms to describe similar types of adaptation to other specialized habitats or food sources. Since "copro-" has been used commonly in the combination "coprophilous" for an organism growing on dung, it might be confusing to use it in the set of terms we want, just as Moser found "pyrophilous" ambiguous.

The Greek word "Iyma" means "filth". If we use the word "filth" to describe the various materials which go into water to form "domestic" sewage in contrast to industrial wastes, and in the case of organic pollutants from industry extend the term to cover these, then we can combine "lyma" with the several suffixes Moser used to form the following terms. *Lymabiont* species grow only in the presence of such pollutants; *lymaphilous* species will grow commonly in the presence of such materials but will also grow elsewhere. *Lymaxenous* species commonly grow elsewhere but may be found in the presence of such materials under special circumstances or as occasional invaders. *Lymaphobous* species are not found in the presence of such materials. In this sense, a *coprophilous* species may be either a *lymabiont* or a *lymaphile*. A *lymaxene* could be an organism which on occasion will colonize the substrate material, while a *lymaphobe* will not grow on such materials. The emphasis here is in nutrient requirements or tolerances, rather than on habitat types or tolerances as is the emphasis in the Kolkwitz (1950) system. It is thought that since the fungi with which we are concerned

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are saprobic, at least in this habitat, these terms are more restrictive than those of Kolkwitz.

A number of types of microorganisms occurring in water, whether clean or polluted, can be studied by direct microscopic observation. Few fungi occurring in these habitats develop fruiting material adequate enough for such study. Most of the species reported below normally inhabit soils where they fruit abundantly and "typically" upon diminution or exhaustion of their substrate. When these fungi occur in sewage or polluted water they are continually bathed in the nutrients used as substrates, and so no need for developing fruiting structures is apparent. Those species which do fruit in such habitats as in the slimes on the stones of trickling filters or in the slimes on the walls of settling tanks do so in such an atypical manner that they can rarely be identified without further study on artificial nutrients.

Techniques used most successfully in the isolation of fungi from polluted waters and sewages have been described by Cooke (1954 b). Except for aquatic fungi, all fungi listed below were obtained on the various media described in that paper, and in repeated trials all of the species have been obtained on the following medium now used in routine isolation work:

Dextrose	10.0	g.
Phytone	5.0	g.
KH_2PO_4	1.0	g.
$MgSO_4.7H_2O$	0.5	g.
Rose Bengal	0.035	g.
Agar	20.0	g.
Water	1000.0	ml.
Aureomycin	0.035	µg./ml.

Since Harvey's work (1952) infrequent attempts have been made to study aquatic fungi. Progress in this work is insufficient for reporting at present.

General descriptions of the locations that have been sampled are presented below. A total of 891 samples has been plated out for possible fungus populations.

Lytle Creek, Clinton Co., Ohio. This relatively small stream receives the effluent from the sewage treatment plant at Wilmington, Ohio. During the sampling period Wilmington had a primary-type sewage treatment plant, which has since been converted to an activated sludge plant. Twelve monthly samples were obtained between April, 1952, and April, 1953. At each of the eight stations established on the stream by the Biology Section of the Robert A. Taft Sanitary Engineering Center, samples were removed of stream water, water and sediments in pools and in riffles, and saturated

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bank soil. The various stations are described from several points of view by Gaufin and Tarzwell (1952) and by Cooke (1954c). Zonal designations used in these papers are based on number of miles from the mouth at Todd's Fork of the Little Miami River, and the pollutional types are as follows: stations 8.7, 2.8 and 1.0, clean zone; stations 7.6 and 4.2, recovery zone; stations 7.2, 6.5 and 5.2, septic zone. The sewage treatment plant effluent enters the stream at station 7.2.

Dayton, Montgomery Co., Ohio. The City of Dayton operates a sewage treatment plant of the secondary type with trickling filters. When monthly sampling started in 1952, sewage entered the plant through detritus tanks. The liquid from which the larger detritus was removed was sent to Imhoff tanks in which primary settling occurred. The sludge from this process was sent to secondary digesters which were heated to 95—98° F. with gas produced during the treatment process. After digestion the sludge was poured on sand drying beds where either under glass or in uncovered beds it was dewatered by evaporation. Following air drying it was ground up, passed through a heated oven, where drying was completed and bacterial sterilization apparently effected, and then it was finally pulverized, sacked, and sold as an organic soil conditioner. Recent changes in the process include the installation of new detritus removal machinery in a revised flow system which directs the liquid to preaeration tanks. Following preaeration, primary settling occours in open tanks. The sludge is then sent to the secondary digestion tanks, and the liquid, as was that from the Imhoff tanks earlier, is sent to the trickling-filter dosing chambers. Both standard rate and high rate dosing is used. In an earlier dosing method the standard rate filters received capacity flow, while the remaining sewage was sent through the high rate filters. In the later method the high rate filters are loaded to capacity, and tle standard rate filters process the remaining sewage and become intermittent in daily operation. Following filtration the sewage from the two types of filters is combined, solids are settled out in a final settling basin, the liquid is passed out to the Great Miami River, and the sludge is returned to the detritus tanks for reprocessing. A change in treatment of sludge includes the installation of vacuum filters. Caked sludge from this process is discarded rather than sacked for sale. Samples from all stages in the treatment of sewage in this plant have been surveyed for their fungus populations.

An additional method of sampling was carried out at the Dayton treatment plant. Glass microscope slides were mounted on hardware cloth frames, and series of frames were exposed on a standard rate and a high rate trickling filter. Pairs of frames were returned to the laboratory at weekly intervals for 57 weeks. After processing, the

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materials on the slide surfaces were plated and the species and colonies found were listed.

Yellow Springs, Greene Co., Ohio. This community maintains a small activated sludge plant. Samples were obtained on five occasions in 1952 and 1953 from the influent, aeration tanks, final settling basin including slime growth on the cement walls, sludge from the bottom of the digester, air drying sludge, plant effluent, and creek water in the effluent stream at several points within a mile of the plant.

Lawrenceburg, Dearborne Co., Indiana. One of the industries in this community produces pharmaceutical products such as penicillin and streptomycin. Permission was granted to remove and study samples from the creek carrying the effluent from this plant to Tanner's Creek, a tributary of the Ohio River. Several types of samples were studied: the dense white growth washed by the water in the stream, a reddish growth farther up the bank, dry soil above any visible growth, scrapings of slimes from various debris in the stream, stream water samples within one hundred feet of the outfall, and samples of sludge which had piled up on the shore away from the stream bed proper. The water in the creek had a strong odor of amyl acetate. The growth on the bank reached one centimeter in depth.

Ithaca, Tompkins Co., New York. Four samples from the vicinity of the primary-type sewage treatment plant were plated by M. A. Rosinski and studied by the writer. These included sewage in the influent channel, plant effluent, water 500 feet below the plant, and water from Cayuga Lake about a mile from shore.

Glendale, Hamilton Co., Ohio. A small trickling filter sewage treatment plant is operated by this community. Samples included influent to the plant, scrapings from the surface stone of the small trickling filter, and effluent from the filter. Samples were taken both during periods when flow was continuous and when it was intermittent.

Fort Ancient Creek, Warren Co., and Cowan Creek, Clinton Co., Ohio. Apparently clean water points on these two streams were chosen for sampling of stream water, water and sediments in pools and in riffles, and saturated bank soil.

Cincinnati, Hamilton Co., Ohio. One sample of Ohio River water from the Public Landing was plated. One sample of slime growth from a building drain in a home at Forestville was studied. Sewage collected from a sanitary sewer has been used in experimental studies. Samples of such sewage settled 24 and 48 hours have been plated, and materials resulting from interaction of this type of sewage "seed" and such industrial wastes as hydro-

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carbons have been plated. Samples from two experimental septic tanks yielded some fungi.

Hocking River Basin, Perry and Athens Co., Ohio. Samples of water and of sediment from Sunday Creek near Chauncey and Corning, from Monday Creek near Shawnee, and from Snow Creek at Murray City, have been plated. These streams had a high acid content since they drain bituminous coal mining areas.

Columbus, Franklin Co., Ohio. The activated sludge sewage treatment plant operated by this city has been sampled once. Sampling stations included plant influent after removal of detritus, a composite of the settled sludges in the settling basin, scum from one of the settling basins, supernatant and digested sludge from the sludge digester, sludge before chemical treatment and after caking on the vacuum filters, settled sewage, activated sludges from the central areas of four of the aerator tanks, liquid in the final settling basin, sludge from the final settling basin, slime developing on settling basin wall, slime developing in the well returning settled sludge to the primary settling basin, and plant effluent.

In the following notes for each species, those not found in polluted habitats will be considered *lymmaphobes,* those present in few isolations or represented by only one or a few colonies will be considered *lymaxenes,* those present commonly (more than 10,000 colonies per gram dry weight of sample) or abundantly (more than 1,000,000 colonies) are considered *lymaphiles,* and the several species apparently restricted to sewage treatment plants or associated only with habitats in which fecal material appears to be the principal substrate will be referred to as *lymabionts.*

Authorities listed for specific epithets are listed according to current texts and monographs. As many as possible have been brought in line with the current edition of International Code of Botanical Nomenclature (Lanjuow, 1952). For perfect states of species of *Aspergillus* and *Penicillium,* names given by both Benjamin (1955) and by Thom and Raper (1946) and by Raper and Thom (1949) are given.

Assistance in identification of certain cultures has been given by the following persons: *Alternaria:* J. W. Groves and E. Simmons; *Ascophanus*: R. P. Korf; *Aspergillus* (in part) and *Penicillium*: D. I. Fennell and K. B. Raper; *Chaetomium*: L. M. Ames; *Epicoccum*: M. B. Schol-Schwarz; *Fusarium*: K. L. Gordon, and W. C. Snyder and H. N. Hansen; certain *Dematiaceae*: S. J. Hughes; *Margarinomyces*: G. A. de Vries; *Mucorales*: C. W. Hesseltine; *Pestalotia*: E. F. Guba; *Pseudoplea*: L. E. Wehmeyer.

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Phycomycetes.

Mucorales.

Absidia corymbifera (Cohn) Saccardo and Trotter. — Lymaxene.

Dayton: Trickling filter slide exposures.

Yellow Springs: Influent.

Absidia ramosa (Lindt.) Lendner. — Lymaxene.

Lytle Creek: Water and sediment in riffle, sta. 8.7.

Dayton: Settled sludge from bottom of Imhoff tanks, heat dried sludge in storage hopper, trickling filter slide exposures.

Mucor brunneus Naumov. — Lymaxene.

Lytle Creek: Water and sediment in pool, sta. 2.8; saturated bank soil, sta. 4.2 and 5.2.

Cowan Creek: Saturated bank soil.

Mucor corticolus Hagem. — Lymaphobe.

Lytle Creek: Saturated bank soil, sta. 1.0.

Mucor fragilis Bainier. — Lymaphile.

The most common member of this order in all habitats sampled.

Lytle Creek: In all habitats sampled and in all months but August. Commonest in saturated bank soil and in pool sediment; common in effluent from Wilmington sewage treatment plant.

Dayton: Common to abundant throughout the plant except in August. Most abundant, but without pattern, in scrapings from surface stone of the strickling filters. In drying sludges increasing in abundance as drying continued. Consistently common in Imhoff tank scum and sludge. Trickling filter slide exposures.

Yellow Springs: Activated sludge, final settling tank, digester sludge, air drying sludge, and creek water carrying plant effluent about $^1/_4$ mile from plant.

Lawrenceburg: Dry soil above creek bank slimes.

Ithaca: Effluent, one block from treatment plant.

Columbus: Settled sludge, sludge from final settling basin, slimes from wall of final settling basin and from sludge return well.

Cincinnati: Experimental septic tank.

Mucor hiemalis Wehmer. — Lymaxene.

Lytle Creek: Saturated bank soils and pool sediments, stations 1.0, 4.2, 5.2, 6.5 and 7.2.

Yellow Springs: Sludge from bottom of digester.

Fort Ancient Creek: Riffle sediments.

Cowan Creek: Saturated bank soil.

Lawrenceburg: Overflow sludge about 10 feet from creek.

Mucor plumbeus Bonorden. — Lymaphile.

Less common than *M. fragilis* but following a similar distribution pattern.

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Lytle Creek: At all sampling stations but in only 8 of the 12 sampling periods. Most common in August but not found in winter months.

Dayton: Throughout the year in similar habitats as *M. fragilis*. Also in plant influent, final settling basin and detritus; trickling filter slide exposures.

Yellow Springs: Activated sludge, final settling tank and digested sludge.

Fort Ancient Creek: Saturated bank soil.

Cowan Creek: Pool sediments, saturated bank soil.

Glendale: Treatment plant influent.

Cincinnati: Sample of Ohio River Water, experimental septic tanks.

Mucor racemosus Fresenius. — Lymaxene.

Lytle Creek: Pool sediment and saturated bank soils, stations 1.0, 5.2, 6.5 and 7.2.

Dayton: Air dried sludge, trickling filter slide exposures.

Yellow Springs: Activated sludge.

Mucor (near) *saturninus* Hagem. — Lymaxene.

Dayton Imhoff tank scum and sludge, secondary digester sludge, scrapings from stones on surface of high rate trickling filter, freshly poured and air dried sludges.

Rhizopus arrhizus Fischer. — Lymaphile.

Lytle Creek: Pool sediments and saturated bank soils, stations 4.2, 5.2, 6.5, 7.2, 7.6 and 8.7.

Dayton: In all seasons: Imhoff tank scum, scrapings from surface of stones in both high rate and standard rate filters, and sludges in all stages of drying sampled.

Yellow Springs: Air drying sludges.

Cowan Creek: Saturated bank soil.

Ithaca: Treatment plant effluent.

Columbus: Sludge from final settling basin, slimes from wall of final settling basin and from walls of sludge return well.

Cincinnati: Domestic sewage seeded into hydrocarbon reduction test both in carboy and experimental trickling filter.

Rhizopus oryzae Went. and Pr. Geerl. — Lymaxene.

Dayton: Imhoff tank sludge.

Columbus: Settled sludge.

Syncephalastrum racemosum (Cohn) Schroeter. — Lymaxene.

Lytle Creek: Pool sediment, sta. 5.2; saturated bank soil, sta. 2.8.

Dayton: High rate filter effluent, freshly poured sludge.

Yellow Springs: Digested sludge, air drying sludge.

Hocking River Basin: Sediment in pool, Monday Creek near Shawnee.

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Zygorhynchus vuilleminii Namyslowski. — Lymaxene.

Lytle Creek: Riffle sediments, sta. 2.8; saturated bank soil, sta. 7.6, 8.7.

Dayton: Air dried and heat dried sludges.

Ascomycetes.

Allescheria boydii Shear. — Lymaphile.

Lytle Creek: Pool and riffle sediments, stations 5.2, 7.2, 7.6 and 8.7.

Dayton: In all seasons. Scrapings from surface stones of both high rate and standard rate filters, Imhoff tank scum, sludge and effluent, secondary digester sludge, effluents from detritus tanks and both types of filter beds and freshly poured and air dried sludges.

Yellow Springs: Digested sludge and air dried sludge.

Ascodesmis microscopica (Crouan) Seaver. — Lymabiont.

Dayton: Trickling filter slide exposure.

Ascophanus carneus (Pers.) Boudier. — Lymabiont.

Dayton: Heat dried pulverized sludge used as lawn soil conditioner.

Carpenteles javanicum (van Beyma) Shear. — Lymaphobe.

Syn.: *Penicillium javanicum* van Beyma.

Lytle Creek: Saturated bank soil, sta. 1.0.

Chaetomium cancroideum Tschudy. — Lymaxene.

Lytle Creek: Pool sediment, sta. 1.0 and 6.5; saturated bank soil, sta. 4.2.

Chaetomium globosum Kunze. — Lymaxene.

Dayton: Trickling filter slide exposures.

Ithaca: Treatment plant influent and 500 ft. down effluent creek.

Eurotium chevalieri Mangin. — Lymaxene.

Syn.: *Aspergillus chevalieri* (Mangin) Thom & Church.

Dayton: Air drying sludge.

Eurotium rubrum Bremer. — Lymaxene.

Syn.: *Aspergillus ruber* (Bremer) Thom & Church.

Lytle Creek: Pool and riffle sediments, sta. 5.2 and 6.5.

Pseudoplea americana (Ell. & Ev.) Wehmeyer. — Lymaxene.

Dayton: Heat dried sludge.

Sartoria fumigata (Fres.) Vuillemin. — Lymaphile.

Syn.: *Aspergillus fischeri* Wehmer.

Dayton: Abundant in pulverized, heat dried sludge stored in open bin.

Aspergillus fumigatus Fresenius.

This is the commonest member of the Aspergilli in our isolations. Found in all seasons and more than half the samples tested.

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Lytle Creek: Found at each sampling but more commonly in the cleaner parts of the stream; more often in saturated bank soil than pool and riffle sediments.

Dayton: Present in all sampling periods and in all stations sampled; commonest in scrapings from surface stone on both types of filters and in air dried sludge. Found in heat dried sludge and trickling filter slide exposures.

Yellow Springs: Activated sludge, final settling tank, digested sludge, air drying sludge and plant effluent.

Lawrenceburg: Pharmaceutical plant effluent, 100 ft. down stream from outfall, slimes on stream bank and debris in stream, dry soil and overflow sludge.

Fort Ancient Creek: Saturated bank soil.

Cowan Creek: Saturated bank soil and pool sediments.

Ithaca: Sewage treatment plant effluent and sample of Cayuga Lake water.

Cincinnati: Ohio River water sample.

Subbaromyces splendens Hesseltine. — Lymabiont.

Dayton: Colonies of this fungus were not noticed on agar plates until March, 1953. They appear as fine, cobwebby filaments on the surface of the agar. Only the imperfect state has been observed and it resembles somewhat the conidial state of *Ascoidea rubescens,* reported commonly from sewage in England. It does not long survive transfer to stock slants. Found in plant influent, Imhoff tank scum and sludge, scrapings from surface stone of both high rate and standard rate trickling filters, plant effluent, and trickling filter slide exposures.

Talaromyces helicus (Raper & Fennell) C. R. Benjamin. — Lymaxene.

Syn.: *Penicillium helicum* Raper and Fennell.

Columbus: Vacuum drier sludge cake.

Talaromyces luteus (Zukal) C. R. Benjamin. — Lymaxene.

Syn.: *Penicillium luteum* Zukal.

Dayton: Trickling filter slide exposures.

Talaromyces stipitatus (Thom) C. R. Benjamin. — Lymaxene.

Syn.: *Penicillium stipitatum* Thom.

Lytle Creek: Saturated bank soil, sta. 6.5.

Dayton: Freshly poured and air drying sludge, digested sludge, trickling filter slide exposures.

Columbus: Digester sludge.

Talaromyces vermiculatus (Dangeard) C. R. Benjamin. — Lymaxene.

Syn.: *Penicillium vermiculatum* Dangeard.

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Dayton: Scrapings from surface stone in standard rate trickling filter.

Thielavia sepedonium Emmons. — Lymaxene.

Dayton: Imhoff tank scum.

Yellow Springs: Air drying sludge.

Basidiomycetes.

Polyporus versicolor L. ex Fr. — Lymaphobe.

Lytle Creek: Saturated bank soil, sta. 1.0.

Fungi Imperfecti.

Melanconiales.

Melanconiaceae.

Pestalotia dichaeta Spegazzini. — Lymaxene.

Lytle Creek: Pool and riffle sediments, sta. 1.7, 8.7; effluent from the Wilmington sewage treatment plant.

Moniliales.

Moniliaceae.

Acremoniella sp. — Lymaxene.

Lytle Creek: Saturated bank soil, pool and riffle sediments, sta. 7.6 and 8.7.

Yellow Springs: Digested sludge, air drying sludge.

Acremonium sp. — Lymaxene.

Dayton: Imhoff tank scum and sludge, effluent from standard rate filter, freshly poured sludge.

Cincinnati: Experimental septic tanks.

Aspergillus candidus Link. — Lymaphile.

Lytle Creek: Saturated bank soil, sta. 2.8, 8.7.

Dayton: Found in all seasons but not all months. Imhoff tank scum, scrapings from surface stone in high rate filter, plant effluent, all sludges from freshly poured through heat dried, trickling filter slide exposures.

Yellow Springs: Activated sludge, final settling tank, plant effluent, digested sludge, water samples from creek carrying effluent about $^1/_4$ and one mile below plant.

Lawrenceburg: Effluent creek near outfall, and dry bank soil.

Cincinnati: Ohio River water sample.

Aspergillus carneus (van Tieghem) Blochwitz. — Lymaxene.

Lytle Creek: Pool sediment, sta. 5.2; saturated bank soil, sta. 2.8.

Aspergillus clavatus Desm. — Lymaxene (approaching lymaphile).

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Lytle Creek: Pool and riffle sediments, saturated bank soil, stations 1.0, 2.8, 5.2, 6.5, 7.6 and 8.7.

Dayton: Scrapings from surface stone on standard rate filter; trickling filter slide exposures.

Ithaca: Influent to sewage treatment plant.

Aspergillus flavipes (Bainier & Sartory) Thom & Church. — Lymaphile.

Lytle Creek: Found in 9 of the 12 sampling periods. Effluent from the treatment plant, pool and riffle sediments and saturated bank soils at all stations.

Dayton: Found in all seasons but not all months. Scrapings from surface stone on standard rate filter, detritus tank effluent, Imhoff tank scum and sludge, freshly poured sludge, heat dried sludge, trickling filter slide exposures.

Yellow Springs: Digested sludge, air drying sludge.

Glendale: Plant influent, scrapings from surface stone in trickling filter.

Aspergillus flavus Link. — Lymaphile.

Lytle Creek: Creek water, riffle and pool sediments and saturated bank soils at stations 1.0, 5.2, 7.2, 7.6 and 8.7.

Dayton: Detritus tank effluent, Imhoff tank scum and sludge, digested sludge, preaerator tanks, settled sludge and sewage, scrapings from surface stone of both high rate and standard rate filter, trickling filter slide exposures, Imhoff tank effluent, and sludges in all stages of drying from freshly poured through heat dried. Usually poorly represented, it was abundant in effluent from the detritus tanks following a rain when run-off may have been carrying a load of spores through the treatment plant.

Yellow Springs: Activated sludge, sludge from bottom of digester, air drying sludge, and in effluent stream a mile below plant.

Columbus: Slimes from wall of final settling basin and from wall of sludge return well.

Aspergillus niger van Tieghem. — Lymaphile.

Lytle Creek: Found in all sampling periods, in all types of samples, and at all stations; however, there was no regular pattern of distribution.

Dayton: Found at every sampling period. Well distributed throughout the plant in most of the types of samples plated. On trickling filter slide exposures.

Yellow Springs: Activated sludge, final settling tank, digested sludge, air drying sludge and plant effluent.

Cowan Creek: Saturated bank soil.

Ithaca: Well represented in all four samples plated.

Columbus: Settled sludge, activated sludge, slimes from walls of final settling basin and sludge return well, and plant effluent.

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Cincinnati: Ohio River water sample; 48-hour settled domestic sewage.

Aspergillus ochraceous Wilhelm — Lymaphile.

Lytle Creek: Saturated bank soil, sediments in pools and riffles in all 8 stations.

Dayton: Found at all sampling periods in most locations sampled, Its presence was weakest in frehsly poured sludges. On trickling filter slide exposures.

Yellow Springs: Activated sludge, final settling tank, air drying sludge.

Cowan Creek: Saturated bank soil.

Columbus: Settled sludge.

Aspergillus sydowii (Bainier & Sartory) Thom & Church — Lymaphile.

Lytle Creek: Found in Spring and Autumn in all stations and types of habitat although not common.

Dayton: Imhoff sludge and effluent, scrapings from surface stone of high rate filter, preaerator, primary settled sludge, plant effluent, air drying, air dry and heat dried sludges; trickling filter slide exposures.

Glendale: Scrapings from surface stone of trickling filter.

Columbus: Slime from wall of final settling basin.

Aspergillus tamari Kita — Lymaxene.

Dayton: Imhoff tank scum.

Aspergillus terreus Thom — Lymaphile.

Lytle Creek: Found only between April and September in all habitats but more commonly in saturated bank soil, and more often in polluted areas.

Dayton: Imhoff tank scum, digested sludge, scrapings from surface stone in both high rate and standard rate trickling filters, freshly poured and air dried sludges.

Yellow Springs: Plant influent, activated sludge, and digested sludge.

Cowan Creek: Saturated bank soil.

Glendale: Plant effluent.

Columbus: Digester supernatant.

Aspergillus ustus (Bainier) Thom & Church — Lymaxene.

Lytle Creek: In all habitats sampled at stations 1.0, 2.8, 6.5 and 7.6.

Dayton: Imhoff tank scum and sludge, freshly poured sludge.

Aspergillus ustus var. *laevis* (Blochwitz) Thom and Raper. — Lymaxene.

Dayton: Imhoff tank scum.

Aspergillus versicolor (Vuillemin) Tiraboshi — Lymaphile.

Distribution of this species roughly parallels that of

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Aspergillus fumigatus although it is less common.

Lytle Creek: Found at all sampling periods except February, in all types of samples and at all stations.

Dayton: Found in only 7 months of the year but in September found in all samples taken from the plant; trickling filter slide exposures.

Yellow Springs: Found at most sampling points and common in activated sludge.

Fort Ancient Creek: Riffle sediment.

Lawrenceburg: Pharmaceutical plant effluent.

Glendale: Plant influent, scrapings from surface stone in trickling filter, plant effluent.

Columbus: Vacuum drier sludge cake, activated sludges, sludge from final settling basin, slime from sludge return well walls.

Cincinnati: Ohio River water sample.

Aspergillus wentii Wehmer — Lymaxene.

Lytle Creek: Creek Water, sta. 7.2; riffle sediment, sta. 4.2.

Dayton: Air dried sludge, trickling filter slide exposures.

Penicillium adametzii Zaleski. — Lymaxene.

Dayton: Imhoff scum, scrapings from stone on surface of high rate trickling filter.

Penicillium albidum Sopp — Lymaxene.

Columbus: Digester supernatant, vacuum drier cake, activated sludge.

Penicillium brevi-compactuum Dierckx — Lymaxene.

Lytle Creek: Found at all habitats in stations 1.0 and 2.8.

Dayton: Scrapings from slime on surface stone in high rate trickling filter.

Penicillium casei Staub — Lymaxene.

Lytle Creek: Found only in March when it was found in creek water at all stations, many saturated bank soil samples and some pool and riffle sediments. More common in lower part of septic zone.

Penicillium charlesii Smith — Lymaxene.

Dayton: Imhoff tank effluent.

Yellow Springs: Activated sludge.

Penicillium chrysogenum Thom — Lymaphile.

Lytle Creek: Found in all types of samples and at all stations but with no definite distribution pattern.

Dayton: Imhoff tank scum, preaerator, digested sludge, scrapings from surface stones of both types of filters, freshly poured, air and heat dried sludges, plant effluent.

Yellow Springs: Activated sludge, final settling tank, plant influent and effluent, digested sludge and air drying sludge.

Lawrenceburg: Common in plant effluent, in slimes developing on debris in creek. At times pools in the creek hold large numbers

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of small, sand-like granules of mycelial balls resulting in as many as 460 million colonies per gram dry weight of sample.

Ithaca: Abundant in all samples taken.

Penicillium citreo-viride Biourge — Lymaxene.

Lytle Creek: Effluent from treatment plant; riffle sediment, sta. 8.7; saturated bank soil, sta. 7.2.

Penicillium citrinum Thom — Lymaxene.

Dayton: Settled sludge, digested sludge.

Penicillium clavigerum Demelius — Lymaxene.

Lytle Creek: Pool sediment, sta. 8.7.

Dayton: Scrapings from surface stone in high rate trickling filter; trickling filter slide exposures.

Penicillium commune Thom — Lymaxene.

Lytle Creek: Stream water, riffle sediments and saturated bank soil, stations 1.0, 2.8, 4.2 and 6.5.

Dayton: Freshly poured sludge.

Yellow Springs: Water in effluent creek 500 feet below plant.

Lawrenceburg: Slime on shore, debris in creek and dry soil.

Cincinnati: Sample of slime from building drain in home.

Penicillium corylophilum Dierckx — Lymaxene.

Dayton: Imhoff tank sludge, plant effluent.

Yellow Springs: Activated sludge, air drying sludge.

Ithaca: Plant effluent.

Penicillium cyaneo-fulvum Biourge — Lymaxene.

Lytle Creek: Creek water, pool sediment and saturated bank soil, stations 1.0, 2,8, and 5.2.

Dayton: Freshly poured sludge.

Penicillium cyclopium Westling — Lymaxene.

Dayton: Imhoff tank scum, scrapings from surface stone in both types of trickling filter, freshly poured sludge.

Yellow Springs: Activated sludge, plant influent and effluent.

Hocking River Basin: Sediment in pools on Sunday Creek below Corning and on Monday Creek near Shawnee.

Penicillium daleae Zaleski — Lymaxene.

Lytle Creek: Saturated bank soil, sta. 1.0.

Dayton: Freshly poured sludge.

Penicillium digitatum Saccardo — Lymaxene.

Dayton: Srcapings from stone in high rate filter.

Penicillium diversum Raper & Fennell — Lymaxene.

Yellow Springs: Digested sludge.

Penicillium duclauxii Delacroix — Lymaxene.

Dayton: Imhoff tank scum.

Penicillium (near) *ehrlichii* Klebahn — Lymaxene.

Lytle Creek: Pool sediment, sta. 6.5.

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Penicillium expansum Link — Lymaxene.

Dayton: In early spring samplings from slime on surface stone of high rate filter, and trickling filter slide exposures.

Penicillium fellutanum Biourge — Lymaxene.

Yellow Springs: Final settling tank, digester sludge.

Penicillium funiculosum Thom — Lymaphile.

One of the three commoner species of *Penicillium* in these habitas, this species was isolated from nearly half of the samples tested.

Lytle Creek: Found at all seasons, in all stations and in all habitats. Found more often in saturated bank soil and in more polluted parts of the stream.

Dayton: Isolated in all months but February, this was present in all habitats sampled prior to use of preaerator and vacuum filter. It has since been isolated from the preaerator sludges. On trickling filter slide exposures.

Yellow Springs: Activated sludge, final settling basin, other habitat sampled within the plant and 500 feet downstream in effluent creek.

Cowan Creek: Stream water, riffle sediment, saturated bank soil.

Fort Ancient Creek: Riffle sediment, saturated bank soil.

Glendale: Scrapings from surface stone in trickling filter, filter effluent.

Ithaca: One mile out in Cayuga Lake in water sample.

Columbus: Activated sludge, slime deposits in final settling basin and sludge return well, plant effluent.

Cincinnati: Experimental septic tank.

Penicillium granulatum Bainier — Lymaphobe.

Fort Ancient Creek: Pool sediments.

Penicillium herquei Bainier & Sartory — Lymaxene.

Lytle Creek: At all stations in saturated bank soil but with no pattern of relative abundance; riffle and pool sediments.

Dayton: Digested sludge, plant effluent, trickling filter slide exposures.

Fort Ancient Creek: Pool sediment and saturated bank soil.

Penicillium implicatum Biourge — Lymaxene.

Dayton: Scrapings from surface stone of high rate filter.

Penicillium islandicum Sopp — Lymaxene:

Yellow Springs: Activated sludge.

Penicillium janthinellum Biourge — Lymaphile.

Lytle Creek: Found in most months and in all stations more commonly in saturated bank soil than in riffle and pool sediments, and in the more polluted parts of the stream.

Dayton: Found in all seasons when it occurred in effluent from detritus tanks, Imhoff tank scum and sludge, digested sludge, freshly

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poured sludge on drying beds, and in scrapings from both types of trickling filter; trickling filter slide exposures.

Yellow Springs: Activated sludge, final settling tank, and air drying sludge.

Cowan Creek: Riffle sediment.

Ithaca: Water sample from Cayuga Lake.

Columbus: Scum from a primary settling basin, vacuum filter sludge cake.

Hocking River Basin: Bottom sediments in Snow Creek at Murray City.

Penicillium jansenii Zaleski — Lymaxene.

Lytle Creek: Saturated bank soils, sta. 4.2, 6.5; pool sediments, sta. 7.6.

Penicillium kapuscinskii Zaleski — Lymaxene.

Lytle Creek: Saturated bank soil, sta. 7.6.

Penicillium lanosum Westling — Lymaxene.

Lytle Creek: Found in late winter, spring and early summer in all stations and most habitats sampled. Commonest in saturated bank soil but also present in sediments in pools and riffles especially above and below the septic zone.

Penicillium lilacinum Thom — Lymaphile.

This is the commonest species of *Penicillium* found in the samples surveyed. It was present in more than $^2/_3$ of the samples.

Lytle Creek: Found in all sampling periods, in all habitats, and at all stations. It presented a pattern of common occurrence in the cleaner parts of the stream with less common occurrence but occasionally high colony counts in the more polluted parts of the stream.

Dayton: Present on all sampling dates, at most points sampled on each date, and in all locations sampled. On trickling filter slide exposures.

Yellow Springs: Present on all sampling dates and at most points sampled on each date.

Fort Ancient Creek: Creek water, sediment in pools and riffles.

Cowan Creek: In all habitats sampled.

Lawrenceburg: Plant effluent, 100 ft. downstream from outfall, slime growth on stream bank, and dry soil above slimes.

Glendale: Plant influent and effluent, scrapings from surface stone in trickling filter.

Ithaca: In all samples.

Hocking River Basin: Sediment in pools in Monday Creek near Shawnee.

Columbus: Found in all types of habitat sampled.

Cincinnati: Ohio River water sample, experimental septic tanks, 48-hour settled domestic sewage.

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Penicillium martensii Biourge — Lymaxene.

Lytle Creek: Riffle sediment, sta. 2.8; creek water, sta. 7.2; and saturated bank soil, sta. 5.2.

Dayton: Imhoff tank scum and sludge, scrapings from slime on stone in a standard rate filter, and in air dried sludge; trickling filter slide exposures.

Yellow Springs: Creek water about $^1/_4$ mile down the effluent creek.

Penicillium (near) *melinii Thom* — Lymaxene.

Lytle Creek: Saturated bank soil, sta. 5.2.

Hocking River Basin: Sediment in pols in Sunday Creek near Corning; in Monday Creek near Shawnee, and in Snow Creek at Murray City. Present in creek water at the latter point.

Penicillium nigricans (Bainier) Thom — Lymaxene.

Lytle Creek: Found in all stations and in all types of habitat, but more common in the clean parts of the stream.

Dayton: Trickling filter slide exposures.

Yellow Springs: Air drying sludge.

Cowan Creek: Saturated bank soil.

Hocking River Basin: Sediment in pools in Snow Creek, Murray City.

Penicillium notatum Westling — Lymaphobe.

Lytle Creek: Riffle sediments, sta. 2.8.

Penicillium ochrochloron Biourge — Lymaphile.

This species was slightly more common in the sampling series than *P. funiculosum* but less common than *P. lilacinum*. The distribution pattern is similar to that of the latter species.

Lytle Creek: Present in all sampling periods, and all habitats, and in all stations sampled. A slight preference for more septic stations was indicated.

Dayton: Found at all sampling dates, in all stations sampled and on trickling filter slide exposures. It was well represented in slimes scraped from the surface stone on both standard and high rate trickling filters as well as in the influents to and the effluents from these filters.

Yellow Springs: Activated sludges, final settling tank, and in other stations sampled.

Fort Ancient Creek: Pool sediments.

Cowan Creek: Creek water and pool sediments.

Lawrenceburg: Slimes on debris in the creek, dry bank soil, and overflow sludges.

Glendale: Influent to filter, slimes on surface stone of filter.

Cincinnati: Slime sample from building drain in a home, domestic sewage seeded into hydrocarbon reduction test.

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Penicillium oxalicum Currie & Thom — Lymaxene.

Lytle Creek: Found in all seasons and in all habitats but was more common in saturated bank soil and in clean water. Found at stations 1.0, 2.8, 5.2, 6.5, 7.2 and 8.7.

Dayton: Imhoff tank scum and sludge, scrapings from surface stone of a high rate trickling filter, freshly poured and air drying sludges; trickling filter slide exposures.

Yellow Springs: Air drying sludge.

Hocking River Basin: Pool sediment in Monday Creek near Shawnee.

Columbus: Activated sludge, slime growths on walls of final settling basin and sludge return well.

Cincinnati: Ohio River water sample, building drain of a home.

Penicillium palitans Westling — Lymaxene.

Dayton: Effluent from Imhoff tanks, slimes scraped from surface stone of both types of trickling filter, air drying sludge.

Yellow Springs: Plant influent, activated sludge, air drying sludge.

Penicillium piscarium Westling — Lymaxene.

Dayton: Imhoff tank scum and sludge, plant influent, scrapings from high rate and standard rate trickling filters, freshly poured and air drying sludges.

Yellow Springs: Air drying sludge.

Columbus: Scum from primary settling basin.

Penicillium psittacinum Thom — Lymaxene.

Lytle Creek: Creek water, sta. 7.2.

Penicillium puberulum Bainier — Lymaxene.

Lytle Creek: Commoner in the cleaner parts of the stream, this species was found in all habitats in most stations in the Spring.

Dayton: Scrapings from surface stone of both types of filter.

Penicillium pulvillorum Turfitt — Lymaxene.

Lytle Creek: Pool sediment, sta. 6.5; saturated bank soil. sta. 2.8.

Dayton: Scrapings from surface stone in high rate filter.

Yellow Springs: Slime on walls of final settling tank.

Penicillium purpureogenum Stoll — Lymaxene.

Lytle Creek: Found in all seasons, all stations, and all habitats sampled although it was commoner in recovery zone stations and in saturated bank soil than in other habitats.

Dayton: Digested sludge; trickling filter slide exposures.

Penicillium raistrickii Smith — Lymaxene.

Lytle Creek: In late spring in the lower three stations in saturated bank soil, and pool and riffle sediments.

Dayton: Scrapings from surface stone of both types of filters.

Ithaca: About a mile from shore in Cayuga Lake.

Penicillium rolfsii Thom — Lymaxene.

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Dayton: Freshly poured sludge.

Penicillium roquefortii Thom — Lymaxene.

Dayton: Scrapings from surface stone of a high rate trickling filter, freshly poured and air drying sludges.

Penicillium rugulosum Thom — Lymaxene.

Lytle Creek: Water samples, saturated bank soil, at the lower three stations.

Dayton: Detritus tank effluent.

Ithaca: Sewage treatment plant effluent.

Penicillium simplicissimum (Oudemans) Thom — Lymaxene.

Lytle Creek: Pool sediment, saturated bank soil, sta. 1.0.

Dayton: Imhoff tank scum.

Penicillium spinulosum Thom — Lymaxene.

Dayton: Freshly poured sludge.

Penicillium stoloniferum Thom — Lymaxene.

Dayton: Imhoff tank scum, heat dried sludge.

Yellow Springs: Digested sludge.

Penicillium tardum Thom — Lymaphobe.

Lytle Creek: Riffle sediments, sta. 1.0, 2.8; saturated bank soil, sta. 8.7.

Penicillium (near) *terlikowskii* Zaleski — Lymaxene.

Lytle Creek: Pool sediment, sta. 7.6.

Penicillium urticae Bainier — Lymaxene.

Dayton: Detritus tank effluent, Imhoff tank sludge and effluent, scrapings from stones on both types of trickling filters, freshly poured and air dried sludges.

Penicillium variabile Sopp — Lymaxene.

Lytle Creek: Found in all stations and in all habitats sampled in most seasons but more commonly in winter, and more commonly in clean water than in polluted water.

Dayton: Imhoff tank scum, air drying sludge; trickling filter slide exposures.

Yellow Springs: Final settling tank.

Glendale: Scrapings from surface stone in trickling filter.

Columbus: Primary settling tank, slime from wall of final settling basin.

Cincinnati: Experimental septic tank.

Penicillium velutinum van Beyman — Lymaxene.

Lytle Creek: Pool sediment, sta. 5.2.

Dayton: Imhoff tank sludge, freshly poured sludge, and trickling filter slide exposures.

Yellow Springs: Final settling tank.

Penicillium viridicatum Westling — Lymaxene.

Dayton: Imhoff tank effluent.

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Fort Ancient Creek: Creek water, riffle sediment.

Cincinnati: Slime growth in building drain in a home.

Penicillium waksmanii Zaleski — Lymaxene.

Dayton: Scrapings from stone at three foot depth in a high rate trickling filter.

Botrytis cinerea Persoon — Lymaxene.

Dayton: Imhoff tank scum.

Yellow Springs: Treatment plant effluent.

Cephalosporium spp. — Lymaxenes.

Cultures of this taxonomically poorly understood genus have been obtained occasionally from most locations studied.

Lytle Creek: Saturated bank soil, sta. 7.2.

Dayton: Detritus tank effluent, Imhoff tank scum and sludge, final settling basin, scrapings from surface stone in standard rate filter.

Yellow Springs: Final settling tank, digested sludge, air drying sludge.

Lawrenceburg: Granular material in pool, slimes developing on debris in creek.

Ithaca: Effluent creek 500 feet downstream from plant.

Fusidium viride Grove — Lymaxene.

Lytle Creek: Riffle sediments, sta. 1.0, 7.2 and 7.6.

Geotrichum candidum Lk. ex Pers. — Lymaphile.

This is one of the commonest fungi isolated. It was present in about three-fourths of the samples studied, sometimes in very large numbers. Its colony appearance is quite variable and it may have sometimes been mistaken for other fungi such as yeasts, ***Pullularia pullulans*** and ***Fusarium aquaeductuum.***

Lytle Creek: Common in all sampling periods but less so in warmer months. Found in all stations and in all habitats sampled. More common in pool and riffle sediments than in water or saturated bank soil. Usually more common in septic zone and effluent from treatment plant.

Dayton: Abundant and observable in slimes on surface stone of both types of trickling filter. Common to abundant in most stations sampled in the sewage treatment plant but has not been found in vacuum filtered sludge nor heat dried sludge. Trickling filter slide exposures.

Yellow Springs: Common to abundant in all stations sampled and always abundant in activated sludge.

Fort Ancient Creek: Saturated bank soil and riffle sediments.

Lawrenceburg: Forming the basic material of the slimes on the creek bank and on the debris in the creek; also present in other samples.

Glendale: Influent, scrapings from surface stone of filter.

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Ithaca: Treatment plant influent and effluent, and present in Cayuga Lake water.

Hocking River Basin: Sediment in pool in Snow Creek at Murray City.

Columbus: Common to abundant in all samples obtained.

Cincinnati: Experimental septic tanks, Ohio River water sample, building drain from a home, 24 hour settled domestic sewage, domestic sewage seeded into hydrocarbon reduction experiments.

Gliocladium catenulatum Gilman & Abbott — Lymaxene.

Lytle Creek: Sediments in pools and riffles, sta. 1.0, 4.2 and 7.6.

Dayton: Detritus tank effluent.

Hocking River Basin: Sediment in pool in Sunday Creek near Chauncey.

Gliocladium roseum (Lk.?) Bainier —Lymaxene.

Lytle Creek: Found at all stations, in all habitats, in all but two of the sampling periods. Commonest in saturated bank soil and more abundant in clean than polluted water.

Dayton: Effluent from detritus tanks, Imhoff tank scum and sludge, scrapings from surface stones on high rate and standard rate trickling filters and in sludges on drying beds. Trickling filter slide exposures.

Yellow Springs: Activated sludge, final settling tank, air drying sludge.

Monilia sitophila (Montagne) Saccardo — Lymaxene.

Lytle Creek: Pool sediment, sta. 7.2.

Dayton: Scrapings from surface stone of high rate filter; trickling filter slide exposures.

Ithaca: 500 feet below treatment plant in effluent creek.

Paecilomyces varioti Bainier — Lymaxene.

Lytle Creek: Found in all habitats sampled at all stations except 7.2 at most seasons, but more often in clean water habitats.

Dayton: Imhoff and digester sludges, scrapings from surface stone on both types of trickling filters, in air drying and air dried sludge, but rare in various effluents in the plant; trickling filter slide exposures.

Columbus: Slime deposit in sludge return well.

Scopulariopsis brevicaulis Bainier — Lymaxene.

Dayton: Imhoff tank scum.

Sepedonium spp. — Lymaxenes.

Yellow Springs: Final settling tank, air drying sludge.

Columbus: Digester supernatant, settled sludge, activated sludge, sludge from final settling basin.

Spicaria elegans (Corda) Gilman — Lymaxene.

Yellow Springs: Sludge from bottom of digester.

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Spicaria violacea Abbott — Lymaxene.

Lytle Creek: Saturated banks soil, creek water, sta. 2.8, 4.2.

Sporotrichum pruinosum Gilman & Abbott — Lymaxene.

Dayton: Trickling filter slide exposures.

Trichoderma alba Preuss — Lymaxene.

Lytle Creek: Pool sediments, saturated bank soil, sta. 4.2, 7.6 and 8.7.

Fort Ancient Creek: Pool sediments and saturated bank soil.

Trichoderma viride Lk. ex Fr. — Lymaphile.

This extremely common fungus, represented by several specific names in several fungus genera in the literature, was found in more than half of the samples tested for fungi. Its tendency to cover a plate quickly was inhibited by the action of rose bengal so that other species present with it could be isolated and studied. Its great variability was demonstrated in the types of colonies produced. The colonies which developed as white molds and have retained this aspect through numerous transfers are noted as the preceding species.

Lytle Creek: Found at all times of the year, in all stations, and in all habitats studied, more common in saturated bank soils, sediments in pools, and in the cleaner parts of the stream.

Dayton: Detritus tank effluent, Imhoff tank scum and sludge, digested sludge, scrapings from surface stone in both types of trickling filters, effluents from trickling filters, sludges in all stages of drying on the drying beds, primary settling basin sludge, detritus removed from the sewage, and on trickling filter slide exposures.

Yellow Springs: Found on all sampling dates. Activated sludge, final settling tank, digested sludge, air drying sludge.

Fort Ancient Creek: Saturated bank soil.

Cowan Creek: Saturated bank soil, pool sediments.

Lawrenceburg: In slimes formed along creek bank and on debris in creek.

Glendale: Scrapings from surface stone on trickling filter.

Ithaca: Plant influent, effluent, and in stream 500 feet downstream from plant.

Hocking River Basin: Sediments in pools in Sunday Creek near Chauncy, Monday Creek near Shawnee, and Snow Creek at Murray City.

Columbus: Settled sludge, sludge in final settling basin, slimes developed on walls of final settling basin and sludge return well.

Cincinnati: Ohio River water sample, building drain from home.

Trichothecium roseum Link — Lymaxene.

Dayton: Scrapings from surface stone in high rate filter, effluent from standard rate filter.

Yellow Springs: Final settling tank.

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Verticillium lateritium Berkeley — Lymaxene.

Lytle Creek: Pool sediments, sta. 4.2; saturated bank soil and sediments in pools and riffles, sta. 1.0.

Dayton: Effluent from detritus tank, Imhoff tank scum, sludge and effluent, digested sludge, preaerator tanks, scrapings from surface stone on both types of trickling filter, effluents from both types of filter, final settling basin, freshly poured and air drying sludge; trickling filter slide exposures.

Dematiaceae.

Alternaria tenuis Nees *sensu lato* — Lymaphile.

The morphologic entity loosely placed under this name is a common saprobic or weakly to strongly plant pathogenic fungus which is produced as the imperfect state of a number of ascomycetous species.

Lytle Creek: Found throughout the sampling period at all stations and in all habitats but more common in saturated bank soil and in cleaner parts of the stream.

Dayton: Found in all types of habitats sampled throughout the year but more common in slimes on surface stones on trickling filters and in late fall and winter samples; trickling filter slide exposures.

Yellow Springs: Final settling tank, digested sludge, air dried sludge and stream water from about 500 feet downstream from the plant.

Fort Ancient Creek: Stream water.

Lawrenceburg: Dry soil from creek bank above slime growth.

Ithaca: In all samples tested.

Columbus: Found in all types of habitat sampled.

Hocking River Basin: Sediments in pools in Sunday Creek near Corning, Monday Creek near Shawnee, and creek water in Snow Creek at Murray City.

Cincinnati: Ohio River water sample, 24-hour settled domestic sewage, domestic sewage seeded into hydrocarbon reduction test.

Cladosporium cladosporioides (Fresenius) de Vries — Lymaphile.

In casual observation of initial isolates of this species it seems to be a very variable organism. However, most variation is eliminated in routine transfer to a stock culture medium. The species is very common, having been obtained in about one-third of the samples tested for fungi.

Lytle Creek: Found in every sampling period, in every station, and in every habitat sampled. More common in saturated bank soil, and in the cleaner portions of the stream.

Dayton: Found in every sampling period and in most of the habitat types sampled although its best development was in slimes

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on surface stones of the trickling filters; trickling filter slide exposures.

Yellow Springs: Found in most stations sampled including activated sludge and the stream carrying the plant effluent.

Fort Ancient Creek: Saturated bank soil.

Cowan Creek: Creek water, saturated bank soil.

Lawrenceburg: Confined to drier habitats sampled.

Ithaca: Found at all sampling points.

Hocking River Basin: Water in stream and sediment in pool in Sunday Creek near Corning.

Columbus: Found at all sampling points.

Cladosporium herbarum (Persoon) Link — Lymaxene.

Yellow Springs: Down stream from treatment plant.

Columbus: Digester supernatant.

Curvularia lunata (Walker) Boedijn — Lymaxene.

Lytle Creek: Saturated bank soil, sta. 2.8, 6.5 and 7.6.

Gliomastix convoluta (Harz) Mason — Lymaxene.

Lytle Creek: Saturated bank soil, pool and riffle sediments, sta. 5.2 and 7.6.

Dayton: Detritus tank effluent, Imhoff tank scum and sludge, preaerator sludge, scrapings from surface stones of standard rate filter, freshly poured and air drying sludges; trickling filter slide exposures.

Yellow Springs: Digested sludge.

Hocking River Basin: Sediment in pool in Snow Creek at Murray City.

Margarinomyces heteromorphus (Nannfeldt) van Beyma — Lymaphile.

This is a very common mold represented in about half of the samples tested for fungi. When present it is usually very abundant but does not appear until 5—7 days after the plates were poured. It appears as small black specks in the agar, which later develop as embedded slimy colonies or as small olive-green or blackish colonies with very small quantities of aerial fruiting material.

Lytle Creek: Found at all sampling periods, in all stations, and in all habitats sampled. More common in pool and riffle sediments and in stream water, especially in the cleaner parts of the stream.

Dayton: Found in all sampling periods. Best developed in slimes on trickling filters but also present in various effluents, Imhoff scum and sludge, digested sludge, freshly poured sludge, preaerator tanks, primary settling basin sludge and effluent, vacuum filter sludge cake and effluent, and detritus. Trickling filter slide exposures.

Yellow Springs: Activated sludge, final settling basin, digested sludge, and other samples tested including the effluent creek.

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Fort Ancient Creek: Creek water, saturated bank soil, and riffle sediment.

Cowan Creek: Creek water.

Lawrenceburg: Plant effluent, slimes forming on creek bank and on debris in creek, and dry soil along bank.

Glendale: Scrapings from slime on surface stone, plant effluent.

Ithaca: Plant effluent.

Hocking River Basin: Sediment in pools in Sunday Creek near Corning, Monday Creek near Shawnee.

Columbus: Found in most habitats including activated sludge.

Memnoniella echinata (Riv.) Galloway — Lymaxene.

Lytle Creek: Saturated bank soil and riffle sediments, sta. 1.0, 8.7.

Dayton: Effluent from detritus tanks, Imhoff tank scum, trickling filter slide exposures.

Humicola grisea Traaen — Lymaxene.

Dayton: Freshly poured sludge.

Columbus: Digested sludge.

Phaeoscopulariopsis sp. — Lymaphobe.

Lytle Creek: Riffle sediments, sta. 1.0.

Phialophora fastigiata (Lagerberg & Melin) Conant — Lymaxene.

Dayton: Scrapings from surface stone on high rate filter, air dry sludge.

Phialophora spp. — Lymaxenes.

Dayton: Imhoff tank scum.

Yellow Springs: Activated sludge, final settling tank, digested sludge, plant effluent.

Pullularia pullulans (de Bary) Berkhout — Lymaphile.

All "black yeast" colonies, which at times resembled colonies of *Geotrichum candidum, Fusarium aquaeductuum,* and perhaps other molds and true yeasts, have been assigned to this heteromorphic species. It is one of the commoner species having been isolated from nearly half the samples tested.

Lytle Creek: Found at all sampling periods, especially in the cooler parts of the year, in all habitats sampled but especially in pool sediments, and at all stations but usually in the more polluted parts of the stream. There was no regular distribution pattern developed.

Dayton: Found in all seasons but commoner in colder parts of the year throughout the sewage treatment plant. Points of greater interest include scrapings from surface stone of both types of trickling filter, sludges during settling and digestion, air dried and heat dried sludge, the preaeration tank and on trickling filter slide exposures.

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Yellow Springs: Found at all sampling periods and in most locations sampled.

Lawrenceburg: Slimes along creek bank and on debris in creek.

Glendale: Plant influent, scrapings from surface stone in trickling filters, plant effluent.

Ithaca: Plant influent, and effluent creek 50 feet below the plant.

Hocking River Basin: Creek water in Sunday Creek near Chauncey.

Columbus: Found in most stations sampled but better developed in sludges and in slimes on walls of final settling basin and sludge return well.

Cincinnati: Building drain in a home, experimental septic tanks.

Stachybotrys atra Corda — Lymaxene.

Lytle Creek: Riffle sediment, sta. 1.0.

Dayton: Imhoff tank scum and sludge, air dried sludge, trickling filter slide exposures.

Yellow Springs: Air drying sludge.

Stemphyllium lanuginosum Harz. — Lymaxene.

Yellow Springs: Activated sludge, final settling tank.

Stemphyllium consortiale (Thuem.) Groves and Skolko — Lymaxene.

Dayton: Trickling filter slide exposures.

Stilbaceae.

Stysanus stemonitis (Persoon) Corda — Lymaxene.

Lytle Creek: Saturated bank soil, sta. 2.8.

Dayton: Scrapings from surface stone of a standard rate filter.

Tuberculariaceae.

Cylindrocarpon radicicola Wollenweber — Lymaxene.

Dayton: Scrapings from surface stone of a high rate trickling filter.

Epicoccum nigrum Link ex Wallroth — Lymaxene.

Lytle Creek: Bank soil, pool and riffle sediments, sta. 1.0, 4.2, 6.5, 7.2.

Dayton: Effluent from detritus tank, plant effluent, trickling filter slide exposures.

Yellow Springs: Air drying sludge.

Ithaca: Plant influent, effluent creek 500 feet downstream, one mile out in Cayuga Lake.

Columbus: Digested sludge.

Cincinnati: Ohio River water sample.

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Fusarium aquaeductuum (Radl. & Rabenh.) Saccardo — Lymaphile.

Syn.: *F. episphaeria* (Tode) Snyder & Hansen.

One of the commonest molds found during the survey, this has been isolated from more than half the samples studied.

Lytle Creek: Found in every sampling period, in every habitat, and in every station. Most frequently found in bank soil, in the lower three stations, and not well represented in mid-summer.

Dayton: Found in every sampling period and most samples. Most abundant on surface stone of both types of trickling filter where it would cover the whole filter with an orange to brown color at which time counts in isolations would reach the hundreds of millions of colonies per gram dry weight of sample. It was found in such peculiar habitats as air drying sludge with excess calcium, and in the alkaline vacuum filter effluent.

Yellow Springs: Activated sludge and throughout the plant in all sampling periods.

Cowan Creek: Saturated bank soil, pool sediments.

Lawrenceburg: Slimes on creek bank and debris in creek, effluent, dry soil and sludge.

Glendale: Influent, scrapings from surface stones in trickling filter, plant effluent.

Ithaca: Found in all samples collected.

Hocking River Basin: Sediment in pools in Snow Creek at Murray City.

Columbus: Found throughout the treatment plant.

Cincinnati: Ohio River water sample, experimental septic tanks, 48-hour settled sewage, domestic sewage seeded into hydrocarbon reduction tests.

Fusarium moniliforme Sheldon — Lymaxene.

Yellow Springs: Air drying sludge.

Fusarium oxysporum Schlechtendahl — Lymaphile.

Lytle Creek: Found at all stations in winter and summer samplings. More frequently found in saturated bank soil, but also present in riffle and pool sediments.

Dayton: Final settling basin, Imhoff sludge and scum, scrapings from surface stone on standard rate filter, air drying sludge, vacuum filter sludge cake, and trickling filter slide exposures.

Columbus: Digester supernatant, activated sludge.

Cincinnati: Domestic sewage used as seed in hydrocarbon reduction test.

Fusarium roseum Link — Lymaphile.

Lytle Creek: Saturated bank soil, pool and riffle sediment, sta. 1.0, 2.8, 4.2, 6.5.

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Dayton: Effluent from detritus tanks, settling basin sludge, freshly poured and air drying sludges, trickling filter slide exposures.

Yellow Springs: Activated sludge, final settling tank, effluent creek water 200 feet below plant.

Cincinnati: Building drain in a home, 24-hour and 48-hour settled domestic sewage, domestic sewage seeded into hydrocarbon reduction test.

Fusarium solani (Martius) Appel & Wollenweber — Lymaphile.

Lytle Creek: Saturated bank soil, riffle and pool sediments, sta. 1.0, 2.8, 6.5, 7.2, 7.6 and 8.7. More common in upper two stations but once abundant in stream water at station 1.0.

Dayton: Digested sludge, Imhoff tank scum and sludge, primary settling basin effluent, final settling basin, effluent from standard rate filters, plant effluent, and sludges in all stages of drying; trickling filter slide exposures.

Lawrenceburg: Plant effluent.

Columbus: Activated sludges from four aerators, sludge from final settling basin.

Cincinnati: 48-hour settled domestic sewage, seeded into experimental trickling filter treating hydrocarbon wastes.

Myrothecium roridum Tode ex Fr. — Lymaphobe.

Lytle Creek: Bank soil, sta. 2.8.

Myrothecium verrucaria (Alb. & Schw.) Ditm. ex Fr. — Lymaxene.

Lytle Creek: Found in most sampling periods in bank soil but also present in sediments in riffles and pools, especially in cleaner parts of the stream but also in recovery and septic zone stations.

Dayton: Imhoff tank scum and sediment, detritus tank effluent, scrapings from surface stone in a high rate trickling filter, trickling filter slide exposures.

Yellow Springs: Final settling tank.

Fort Ancient Creek: Creek water.

Columbus: Activated sludge.

In addition to the above records for which species names and generic groupings have been established, identification of some groups of cultures has not been completed. Unidentified or sterile cultures of Hyphomycetes are the least satisfactory group of cultures with which to work. A number of cultures of Sphaeropsidales can be assigned to approximately 20 categories, but pure culture work with strains not associated with specific hosts is difficult. Red yeasts assignable to *Rhodotorula,* and white yeasts assignable to *Torulopsis. Trichosporon, Candida* and other genera of imperfect yeasts are in the process of taxonomic studies.

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