EXHIBIT OF FUNGI PATHOGENIC TO MAN SHOWN AT THE ONE HUNDRED AND FIFTY-THIRD ANNIVERSARY OF THE MASSACHUSETTS MEDICAL SOCIETY*

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THE pictures on the following pages were taken from an exhibit shown at the meetings of the Massachusetts Medical Society in June, 1934. The purpose of the exhibit was twofold; first, to indicate in a general manner the position of the fungi pathogenic to man in the plant kingdom, their relation to other fungi and to plants as a whole; and, secondly, to present the common pathogens in their more important aspects of diagnosis and culture, the lesion, the appearance of the fungus in tissue from the lesion, and its characteristic spores in culture.

THE PLACE OF FUNGI IN THE PLANT KINGDOM

The plant kingdom is divided into four great groups, the thallus plants, the mosses, the ferns, and the seed plants.

The *thallus plants* (Thallophyta) are so named because they have thalloid bodies, that is, bodies that are relatively simple and undifferentiated. The two sub-divisions of the thallus plants, the *Algae* and the *Fungi*, are distinguished by the presence or absence of chlorophyll, the green coloring matter which enables plants to synthesize carbohydrates from water and carbon dioxide in the presence of light. The *Algae* all contain chlorophyll and are therefore free-living. The *Fungi* all lack chlorophyll and are necessarily parasitic, living on other organisms, or saprophytic, living on the dead remains of other organisms.

The first of the six classes of fungi, the bacteria, cause many serious diseases of plants and animals.

The second class, the slime molds (Myxomycetes), are small saprophytes of no practical importance.

The following classes, called collectively the higher fungi (Eumycetes) are distinguished by the fact that they are made up of thread-like strands (hyphae), either in loose cottony masses as in bread mold or in firm, compact bodies as in mushrooms. They are classified according to their method of producing sexual (perfect) spores, that is, spores that are produced as the result of a sexual fusion of nuclei. They produce also non-sexual (imperfect) spores which help spread the fungus rapidly.

The true molds (Phycomycetes) are distinguished from the following classes by the fact that their hyphal threads contain no cross partitions. They include common black bread mold, fungi that cause diseases of insects and fish, and many important blights and mildews of plants, including the potato blight that was the chief cause of the Irish famine of 1845.

The sac fungi (Ascomycetes) are so called because their sexual spores are produced inside a sac cell (*ascus*). They include yeasts important in brewing and baking, the fungus from which ergot is obtained, and destructive plant pathogens such as the chestnut bark disease that is killing most of our native chestnuts.

The club fungi (Basidiomycetes) are so named because their sexual or perfect spores are borne on special club-shaped cells (basidia). They include organisms that cause serious plant diseases such as the smut of corn and the rusts of wheat and of white pine, and the mushrooms and puffballs, some of which are important because they contain violent poisons, and some because they are edible.

The fungi that are placed in the last class, the imperfect fungi (Fungi Imperfecti), resemble those of the three preceding classes in that they are composed of hyphal threads, but differ from them in that, so far as is known, they produce no sexual or perfect spores, but only non-sexual or imperfect ones, hence their name. Any hyphal fungus which has no known perfect spores is placed in the imperfects; it will be seen, therefore, that the imperfects are not a homogeneous, closely related group as are the other classes, but rather a dumping ground for forms whose true position cannot yet be determined. The group contains many important organisms, the green bread molds, the characteristic molds of cheeses, various plant pathogens, mildews that rot cloth, and, most significant for our purpose, almost all the fungi pathogenic to man.

The *mosses* (Bryophytes) and *ferns* (Pteridophytes) are small groups of no great economic importance, which reproduce by spores as do the thallus plants but have well differentiated tissues suggesting those of seed plants.

The *seed plants* (Spermatophytes) are the most highly developed group, and are dominant in our vegetation to-day. They are divided into two groups, the cone-bearing plants (Gymnosperms) comprising the evergreen trees and shrubs; and the flowering plants (Angiosperms) that include most of our food and drug plants, ornamentals, grasses, weeds, and broad-leaved trees.

*Mycological work under the direction of William H. Weston, Jr., Professor of Cryptogamic Botany, Harvard University. Clinical material from Department of Dermatology, Boston City Hospital.

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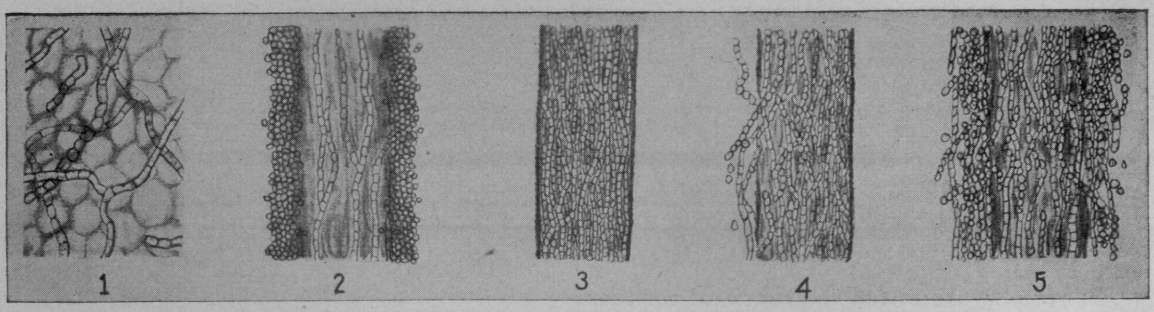
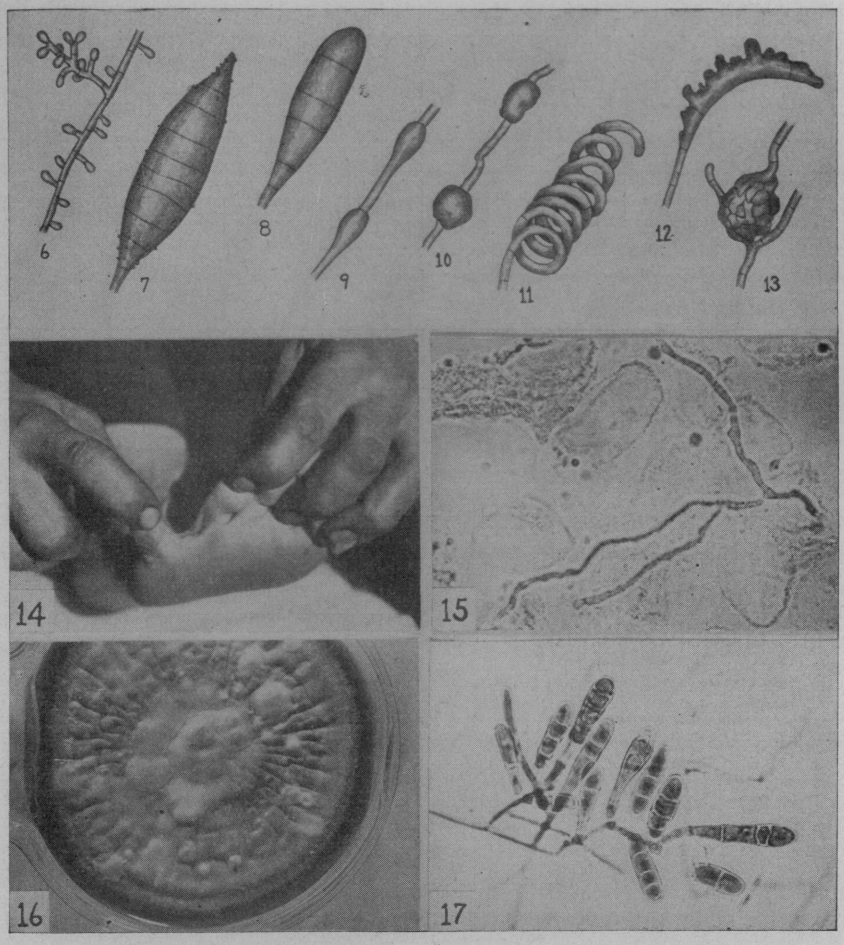




FIGS. 1-33. The *Dermatophytes*, a specialized group of imperfect fungi growing on the skin, hair and nails.

FIGS. 1-5. Sabouraud's classification of the dermatophytes, based on the position of the fungus in the infected tissue.

1. *Epidermophyton*—fungus growing in the skin only; never invading the hair.
2. *Microsporum*—fungus growing in the hair, forming a sheath of "spores" in "mosaic" arrangement (not in rows or chains) around the outside of the hair.
3. *Trichophyton endothrix*—fungus growing in the hair, forming "spores" in chains, wholly within the hair shaft.
4. *Trichophyton neo-endothrix*—fungus growing in hair, forming "spores" in chains, mostly inside the hair shaft but with a few strands outside.
5. *Trichophyton ectothrix*—fungus growing in the hair, forming "spores" in chains, abundant outside as well as inside the hair shaft.

FIGS. 6-13. Types of spores and specialized hyphae found on the Dermatophytes when grown in culture, on which various tentative botanical classifications are based.

6. Aleuriospores or meristem spores.
7. Boat-shaped fuseau (spindle spore).
8. Club-shaped fuseau.
9. "Raquette" hypha.
10. Chlamydospores.
11. Spiral hypha.
12. Pectinate hypha.
13. Nodular body.

FIGS. 14-17. *Epidermophyton.*

14. Epidermophytosis of the toes.
15. The fungus in a skin scale.
16. Culture, showing white tufts of so-called "pleomorphic" hyphae growing from the typical colony.
17. The spores borne in culture—club-shaped fuseaux.

SES

FERNS

SEED PLANTS

CONE-BEARING PLANTS

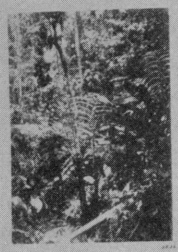
FLOWERING PLANTS

MOSS

MOSS

MOSS

FERNS



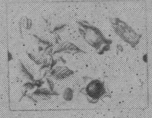
TREE FERN

HORSETAIL

PINE CONE

PINE TREES

FIR TREE



BELLADONNA, SOURCE OF ATROPINE

WILLOW TREE

WATER LILY

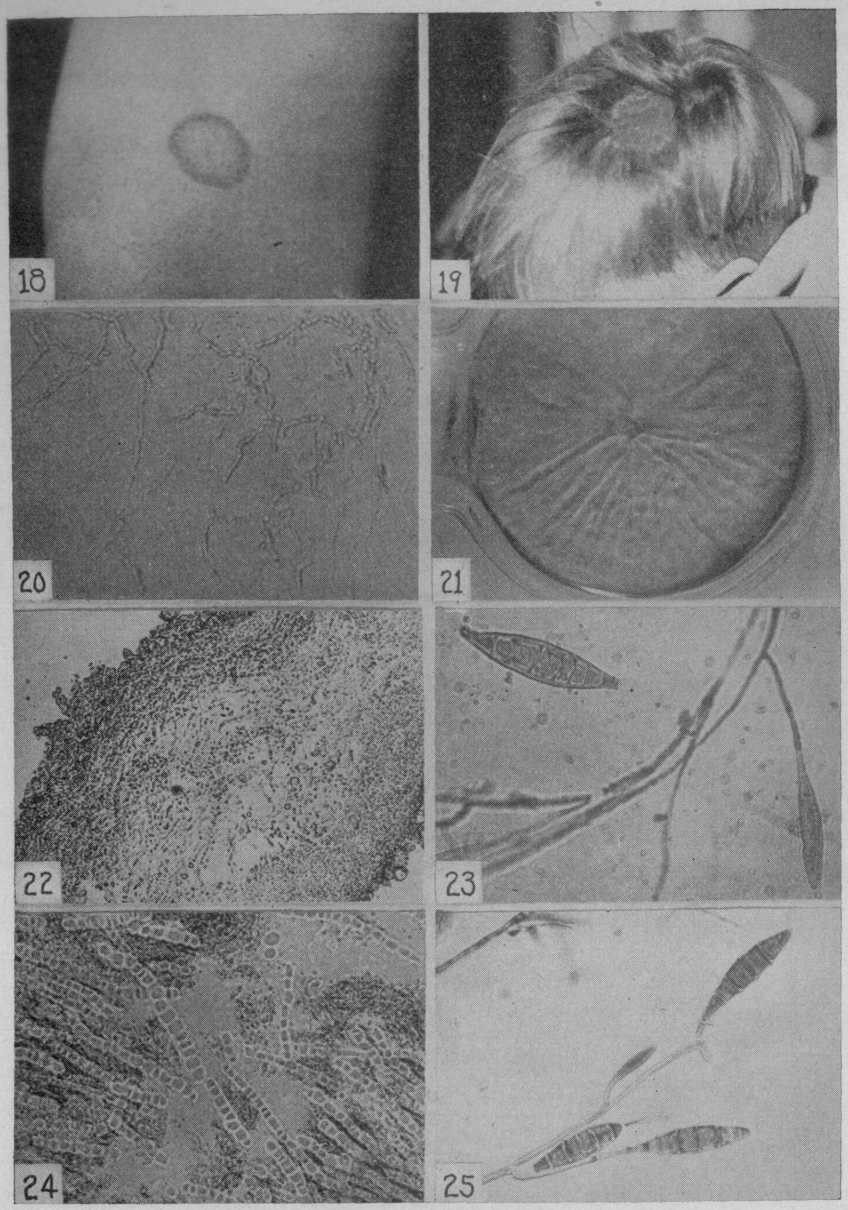
SUGAR CANE

POTATO

WHEAT

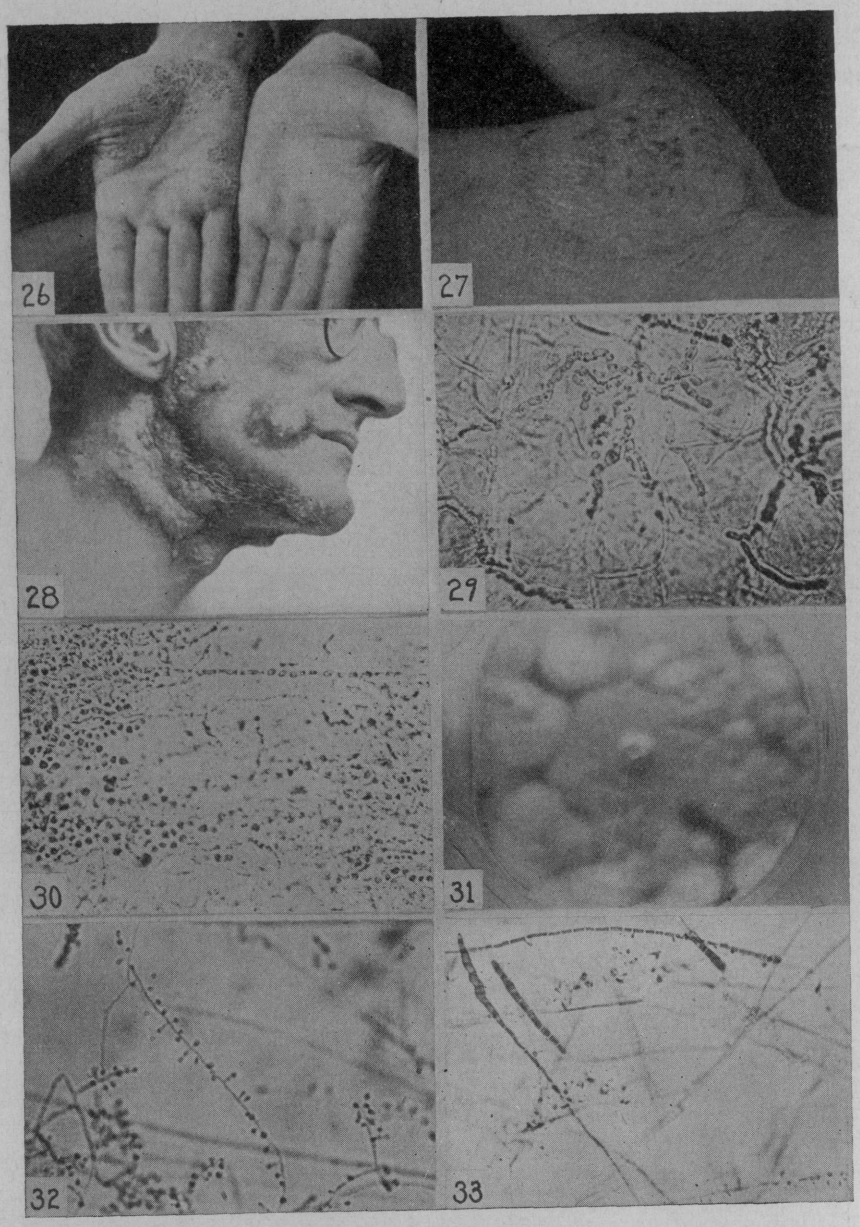
THE PLACE OF FUNGI IN THE PLANT KINGDOM

- THALLUS PLANTS
  - ALGAE
    - GREEN SEA WEED
    - RED SEA WEED
    - BROWN SEA WEED
  - FUNGI
    - BACTERIA
      - BACTERIA IN CULTURE
      - BACTERIAL GALL ON ROSE
      - BACTERIAL GALL ON PRIVET
    - SLIME MOLDS
      - MILDEW ON CORNLEAF
      - DOWNY MILDEW ON CUCUMBER
    - MOLDS
      - CATERPILLAR KILLED BY MOLD
      - COMMON BREAD MOLD
      - FISH KILLED BY WATER MOLD
      - LEAF SPOT CAUSED BY MOLD
    - SAC FUNGI
      - THIS FUNGUS, PARASITIC ON GRAINS, IS THE SMUT OF BARLEY
      - BAKERS YEAST
      - CHESTNUT BARK DISEASE
      - SAPROPHYTIC FUNGUS ON PAPER
      - FUNGUS ON INSECT
    - CLUB FUNGI
      - EAR OF CORN DEFORMED BY SMUT FUNGUS
      - A POISONOUS MUSHROOM
      - WOOD DESTROYING FUNGUS
      - PUFFBALLS
      - EDIBLE PUFFBALL
      - MORE MUSHROOMS
    - IMPERFECT FUNGI
      - CHARACTERISTIC MOLD OF MUSEUMS
      - GREEN BREAD MOLD
      - LEAF SPOT DISEASE
      - LOS ANGELES
      - CLOTH OF GAS CELL ATTACKED BY MOLD (From the Los Angeles)
      - **FUNGI PATHOGENIC TO MAN**
- MOSSES
  - "OSTRICH FEATHER" MOSS
  - "HAIR CAP" MOSS
  - "WHITE" MOSS
- FERNS
  - FERN
  - TREE FERN
  - HORSETAIL
- SEED PLANTS
  - CONE-BEARING PLANTS
    - PINE CONE
    - PINE TREES
    - FIR TREE
  - FLOWERING PLANTS
    - BELLADONNA
    - WILLOW TREE
    - SUGAR CANE
    - POTATO



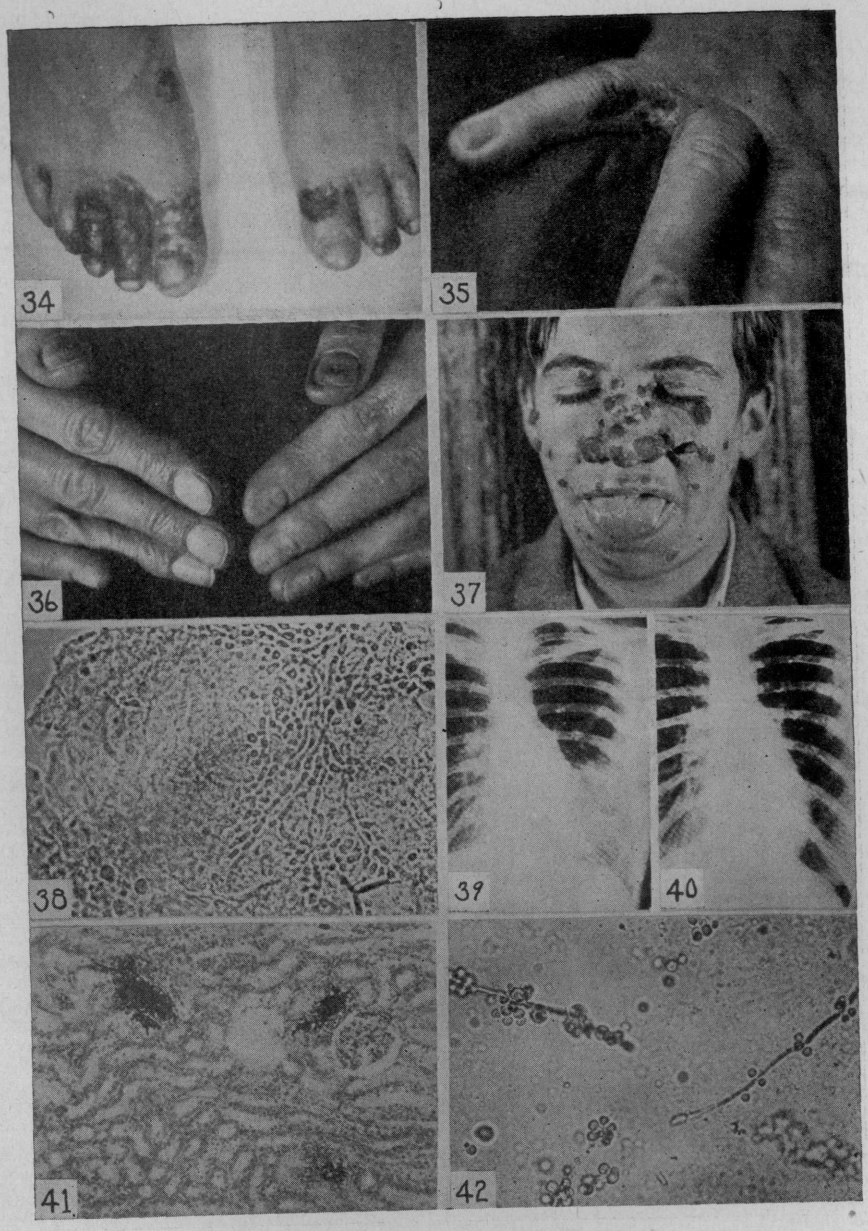
FIGS. 18-25. *Microsporum.*

18. Ringworm of the smooth skin.
19. Ringworm of the scalp.
20. The fungus in a skin scale.
21. Culture (*Microsporum lanosum*).
22. The fungus in a hair (*Microsporum lanosum*).
23. The spores borne in culture—boat-shaped fuseaux (*Microsporum lanosum*).
24. The fungus in a hair, greatly magnified (*Microsporum gypseum*).
25. The spores borne in culture—boat-shaped fuseaux (*Microsporum gypseum*).



FIGS. 26-33. *Trichophyton.*

26. Trichophytosis of the palms.
27. Trichophytosis of the smooth skin.
28. Trichophytosis of the beard.
29. The fungus in a skin scale.
30. The fungus around a hair of the beard.
31. Culture.
32. The spores borne in culture—aleuriospores or meristem spores.
33. The spores borne in culture—meristem spores and irregular fuseaux.

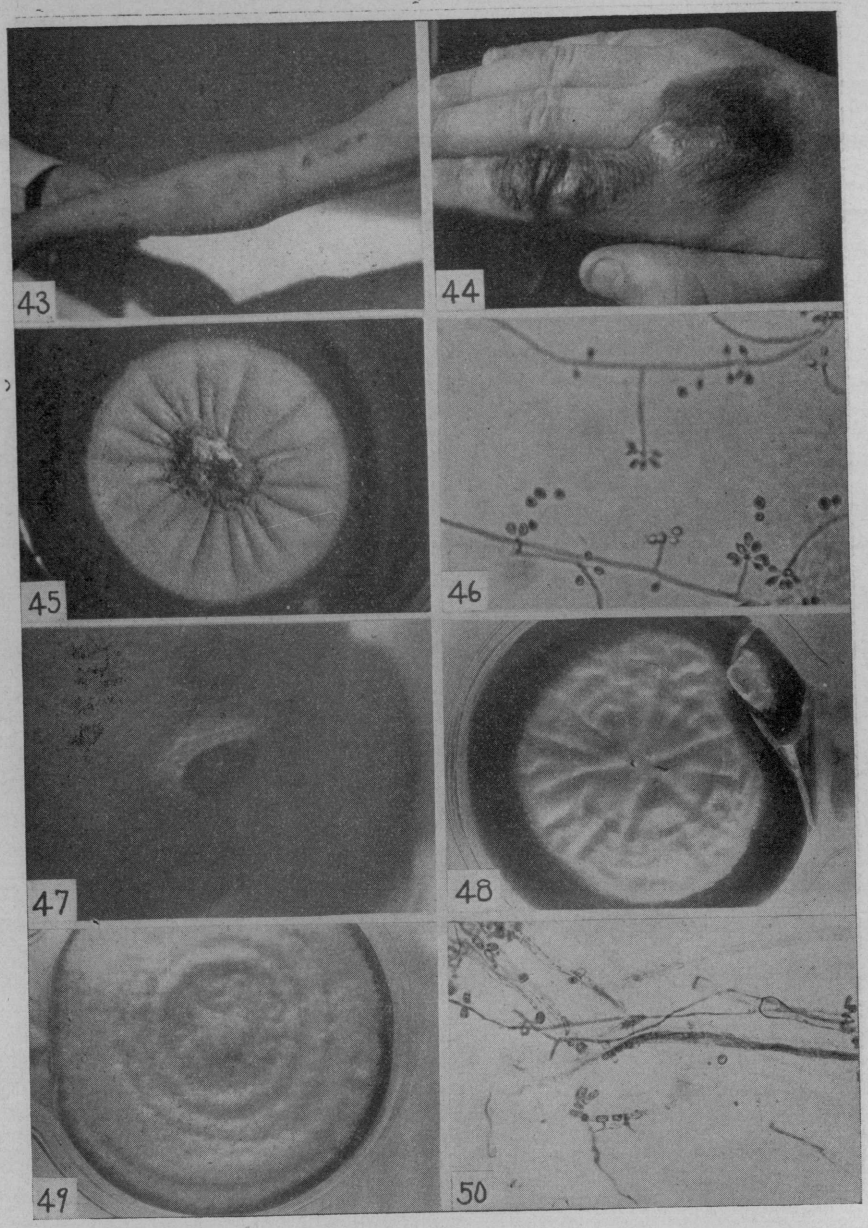


FIGS. 34-42. *Monilia*, a yeast-like imperfect fungus.

34. Moniliasis of the toes.
35. Moniliasis of the finger webs ("Washerwoman's eczema").
36. Moniliasis of the nails; note transverse ridges.
37. Moniliasis of the face and tongue.
38. The fungus in nail tissue.
39. Moniliasis of the lungs, showing density in the left mid-chest.
40. Moniliasis of the lungs, showing the left mid-chest entirely cleared six months later.

(Figs. 39 and 40 through courtesy of Dr. H. J. Bakst, Dr. J. B. Hazard, and Dr. J. A. Foley. Pulmonary Moniliasis, J. A. M. A. 102:1208-1213. 1934.)

41. The fungus (stained) in kidney tissue of rabbit injected with *Monilia*. (Through courtesy of Dr. R. N. Nye, Dr. L. G. Zerfas, and M. A. Cornwell. The Pathogenicity of Yeast-like Fungi Isolated from the Human Gastrointestinal Tract. Amer. Jour. Med. Sci. 178:515. 1929.)
42. The fungus in culture, hyphal strands and budding spore forms in agar.



FIGS. 43-46. *Sporotrichum.*

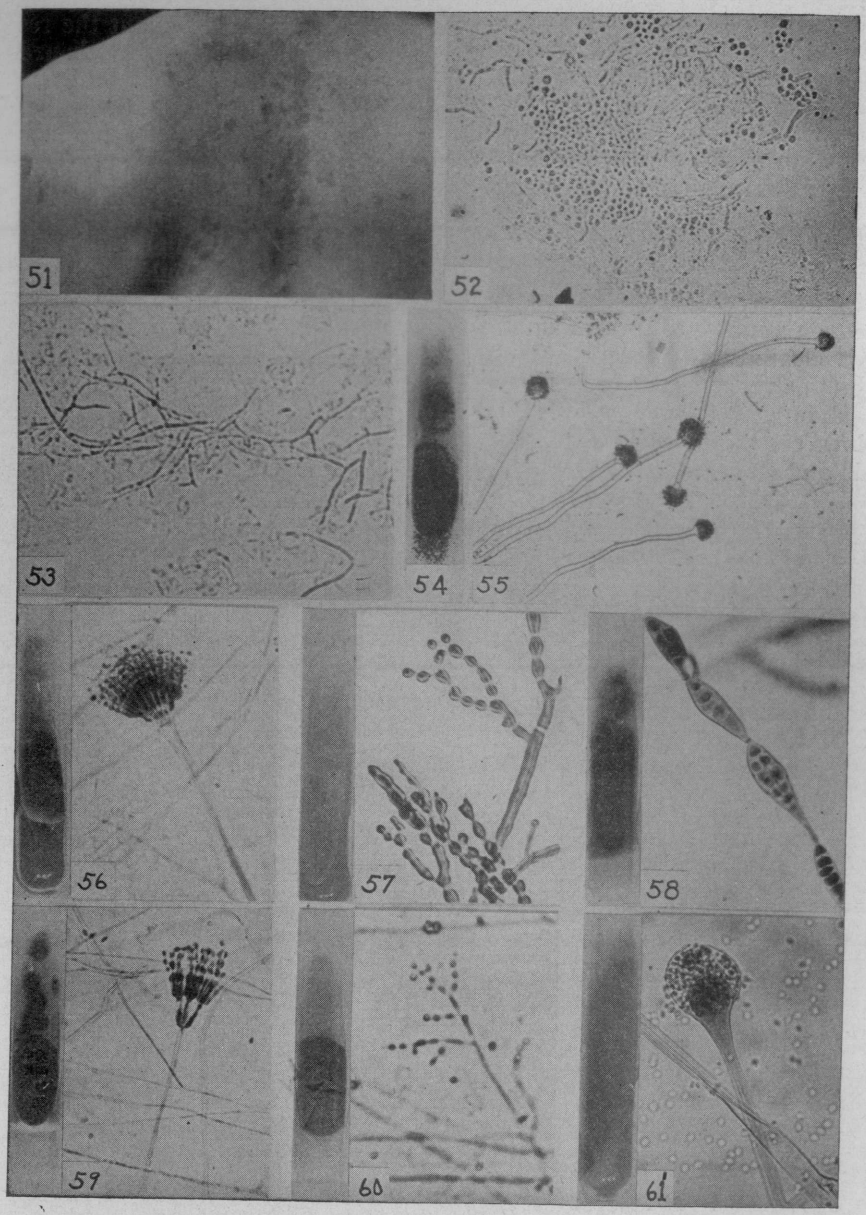
43. Sporotrichosis, secondary lesions in lymph glands of the arm.
44. Sporotrichosis, primary lesion on finger and a secondary lesion on hand. (The dark stain is iodine.)
45. Culture.
46. Spores borne in culture; note especially those borne on the sides of the hyphae.

FIGS. 47-48. *Blastomyces.*

47. Lesion of Blastomycosis on the neck.
48. Culture.

FIGS. 49-50. *Coccidioides.*

49. Culture.
50. The fungus in culture; note the absence of any true, specialized spores.



FIGS. 51-52. *Malassezia*, a saprophyte in the dead outer skin.

51. Lesions of Tinea versicolor on back.
52. The fungus in a skin scale; note abundant round "spores" and short hyphal threads. This fungus is not known with certainty to grow in culture.

FIGS. 53-55. *Aspergillus niger*, a semi-saprophyte on wax and cellular débris in the outer ear.

53. The fungus in wax and cellular débris.
54. Culture; note black spore heads.
55. The spores borne in culture, small round spores in chains, borne on the swollen tips of specialized hyphae.

FIGS. 56-61. Common contaminants in cultures, and their characteristic spore forms.

56. Aspergillus (green mold).
57. Neurospora (Monilia) (orange mold).
58. Alternaria (usually black or dark green).
59. Penicillium (blue-green mold).
60. Hormodendrum (black or dark green).
61. Mucor (black bread mold).

COMMON FUNGOUS DISEASES

The illustrations show the important diagnostic and cultural aspects of the more common fungi pathogenic to man.

Diagnosis is suggested by the appearance of the lesion and completed by finding the fungus in the tissue or growing it in culture. To make a direct examination of the tissue, in skin diseases pull out hairs, scrape off scales or clip off tops of vesicles in the most active part of the lesion; place some of them on a glass microscope slide in a drop of thirty per cent potassium hydroxide and put a coverslip on the drop; let it soak from fifteen minutes to several hours until the tissue is cleared and transparent under the microscope (this process may be hastened by warming the slide gently over a flame); examine with low and high magnifications for hyphal threads and "spores". In systemic diseases, according to the type of disease remove and examine pus, sputum or tissue from the lesion.

To make a culture, plant the rest of the fragments of tissue in tubes of Sabouraud's "proof" agar (glucose 4 Gm., peptone 1 Gm., agar 2 Gm., water 100 cc.). Keep the tubes at ordinary room temperature. Some pathogenic fungi are very slow growing and may not appear until three or four weeks after planting. Plant a large number of fragments, since some pathogens are quite difficult to obtain in culture.

The pathogens should not be confused with other fungi that occur very commonly as contaminants in such tubes. Most pathogenic fungi are white or shades of yellow, and slow growing. Green or dark-colored colonies and light-colored colonies that fill the tube in a few days are usually contaminants.

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