NOTES

SOME SOIL FUNGI FROM AN ALASKAN TUNDRA AREA.

Very little is known of the populations of organisms occurring in soils and surface waters in North America north of the 60th parallel. From work done in Europe it may be assumed that several types of fungal populations occupy such habitats. Féher[1] compared soils from as far north as 69°30′ in Lappland with those from as far south as Hungary. He found at least 39 species of soil fungi in the more northern samples and showed that bacteria occur also throughout this area, but that the numbers of bacterial colonies declined toward the north more rapidly than the numbers of fungal colonies, giving higher fungus to bacterium ratios as northern latitudes were approached.

Verbal reports by students of northern biotas indicate a fairly complex population of fleshy fungi in the tundra-covered regions of North America. Savile[2] reported on the occurrence of 28 species of fleshy and plant-parasitic fungi on Somerset Island, District of Franklin, in the middle of the Canadian Arctic Archipelago; although this island lies between 72° and 74°N. and is treeless many of the species reported are widespread in more southern regions. Kelsall[3] has noted the occurrence of a poisonous mushroom north of the tree-line in the Northwest Territories. Favre[4] reported on a 15-year survey of those soil fungi that produce fleshy fruit bodies and that occur above timberline in the Swiss Alps. He suggested, on the basis of comparison between alpine and tundra populations, that the fungi could live in both types of habitats and that a large percentage of these species formed mycorrhizae in association with low-growing woody plants common to both areas.

The following report is based on samples of soil and water collected in a tundra area and is restricted to a listing of certain soil moulds found there.

In August and September 1957 and June 1958 the junior author collected a series of water and soil samples from which a number of mould and yeast cultures were isolated. The samples were obtained while making a survey of enteric infections among the Eskimos of Southwestern Alaska. Specifically, sampling was carried out within a 6-mile radius of the Eskimo village of Napaskiak, about 400 miles west of Anchorage, near the head of Kuskokwim Bay.

A good description of the area in which the sampling was done was presented by Williamson[5]. The region lies in the ecotone between the forest and tundra regions, and the sampling was carried out in areas described as "wet tundra" and "heath tundra". In this region the average annual precipitation is 19 inches, the climate approaches the marine type, with a mean annual temperature of 30°F., a monthly mean for July of 55°F. and for January of 6°F., and an average growing season of 102 days. With the climate as much cool-maritime as arctic, the soil fungi are probably low-temperature species adapted to a cold environment. The article by Williamson is illustrated by maps and photographs giving the geographic location and illustrating environmental conditions.

In August 1957 five pond and three soil samples were collected for a preliminary investigation into the microorganisms of this area. In September 1957 six soil and pond samples, including four (Nos. 1-4) from the permafrost area on the west side of the Kuskokwim River, were collected and in June 1958

Table 1. Temperature and pH values of tundra ponds, and soils.

Date of collection	*Sample number*	*Pond*		*Soil*	
		Temperature °C	*pH†*	*Temperature °C*	*pH†*
August, 1957	1	15.5			
	2	12.5	7.02		6.53
	3	14.5	7.13		
	4	10.5	7.28	5.5	6.52
	5	12.0	7.50	5.5	6.52
September, 1957	1				
	2		7.37		5.72
	3		7.23		4.83
	4		7.28		6.07
	5		7.37		6.60
	6		7.08		4.51
			6.92		4.98
June, 1958	1	12.5	7.28		7.07
	2	12.0	6.65		5.83
	3	11.0	6.48		4.50
	4	12.5	6.28		4.58
	5	12.0	6.73		5.58
	6	13.0	6.88	8.5	5.93
	7	12.5	6.79	1.0*	5.68
	8	12.5	6.53	0.5*	5.24
	9	12.5	6.51	0.5*	5.21
	10	12.0	6.02	0.0*	4.41

* Temperature taken at frost level after clearing away surface vegetation.
† pH readings made with Beckman meter Model G.

ten samples of soil and pond water. Soil samples taken near ponds were assigned the number of the pond. Soil and water samples were plated in BBL Rose-Bengal Agar containing aureomycin. Plates were incubated in the field at 20°C. for 4 to 5 days when counts were made and isolates transferred to tryptone-glucose-extract agar slants. Table 1 gives the temperatures and pH levels of the ponds and soils from which samples were taken.

Pond samples were taken from near the surface of ponds whose waters were low in minerals and high in humic colloids. Soil samples were taken 6 to 12 inches below the surface in bog-type soils with a tough fibrous brownish mat on the surface and a dark-colored, humus-rich soil underneath. In general the samples ranged from acid to neutral in reaction, pH of the water samples varying from 6.02 to 7.50 and from 4.41 to 7.07 for the soils.

Plate counts of moulds were made on most water and soil samples. As shown in Table 2, pond samples had considerably smaller counts than soil samples on the basis of volume of original sample tested. Yeasts were more sporadic in occurrence than moulds, and counts were not made of these colonies. Table 2 shows that mould counts from pond water samples ranged from less than 1 to 20 per ml, with an average of 6 per ml. Soil samples yielded a range of colonies from 320 to 2,200,000 per ml. The median, 14,000 colonies per ml, is probably a more accurate estimate of the mould populations of these soils than the average of the 17 samples reported.

Isolates on tryptone-glucose-extract agar slants were shipped by air mail to Cincinnati where they were transferred to stock culture slants of neopeptone-dextrose agar, on which they have been maintained to date.

The following fungi were found among these isolates. They include range extensions for most species, since little if any work has been done on the fungi of the soils of Alaska, especially those tundra soils located west of the fertile or glacial coastal valleys of southeastern Alaska (Cash[6]; Cooke and Lawrence[7]; Sprague[8]; Sprague and Lawrence[9]).

PHYCOMYCETES. **Mucoraceae.**

Mortierella isabellina (Oudemans) Zycha. Soil sample No. 5, September 1957 (30).

Mucor angulisporus Naumov. Pond water, August 1957 (62b); Soil No. 1 (12), and No. 10 (87, 90), June 1958.

Mucor corticolus Hagem. Soil No. 1, June 1958 (63c).

Mucor hiemalis Wehmer. Soil No. 4, September 1957 (24); Pond 5 (52) and 10 (59), Soil No. 8 (79), June 1958.

FUNGI IMPERFECTI. **Moniliaceae.**

Botrytis terrestris Jensen. A culture tentatively assigned to this species was isolated from soil at Station No. 8 in June 1958 (82).

Penicillium expansum (Link) Thom. Isolated from Soil No. 9, June 1958 (84).

Penicillium implicatum Biourge. This species of *Penicillium* occurred on several occasions and was isolated from Pond No. 4 (17) and Soil No. 1 (20) and 4 (23), in September 1957; and from Soil No. 4 (69); 8 (80) and 10 (88), in June 1958.

Penicillium raistrickii G. Smith. Isolated from Soils No. 2 (64) and 10 (89), June 1958.

Penicillium spp. It is difficult to get isolates of *Penicillium* in pure culture upon preliminary isolation. Isolates from Ponds No. 1 and 2, September 1957; Ponds No. 3, 4, and 7 and Soil No. 9, including culture numbers 13, 14, 40, 42, 46, 55 and 83, have not yet been identified to species.

Sporotrichum epigaeum Brunard var. *terrestre* Daszewska. Two isolates from soil Area No. 7, June 1958 (73, 74a), are tentatively assigned to this species. In appearance they are similar to the one listed under *Botrytis* above but they are pure white with hyaline spores.

Trichoderma viride Pers. ex Fr. Isolated from Pond No. 3, September 1957 (15, 16), and Soil No. 2, June 1958 (63a). It is interesting that at room temperature on rich culture media the four isolates from southwestern Alaska should revert to an almost completely mycelial condition. At the present time (Feb. 1960) only one of the four isolates resembles a *Thichoderma* culture, while in the early summer of 1958 all four were typical green cultures of *Trichoderma*.

Moniliaceae spp. In all isolation work based on soil and water samples a certain number of cultures remain anonymous since they do not sporulate under laboratory conditions. Cultures from the following habitats fall in this category: the soil samples in August 1957; Pond No. 5; Soil No. 2, September 1957; Ponds No. 2, 3, 4, 5, 10; Soils No. 2, 6, 8, and 9, June 1958; (5, 18, 21, 36, 41, 45, 51, 60, 61b, 63b, 65, 73, 76a, 81, 82, 85, 86).

Dematiaceae.

Cladosporium cladosporioides (Fres.) deVries. Isolated from Soil No. 4 (68) and No. 6 (76b), June 1958.

Dematiaceae spp. Three cultures, assignable to species within this family should they sporulate at a later date, are reported: Isolated from Ponds No. 2 and 3, June 1958 (38a, 43, 44a).

Tuberculariaceae.

Fusarium oxysporum Schlech. em. Snyder and Hansen. A strain, tentatively assigned to this species, was isolated from Pond No. 5, September 1957 (19).

Phomaceae.

Phoma terrestris H. N. Hansen. Cultures of *Phoma* isolated from soil or water samples have to be filed immediately with the unidentifiable species or strains in a culture collection unless a definite host relationship can be established. The original description of this species allows a wide degree of latitude in making identifications of soil isolates. Within the series of cultures tested for pathogenicity on onions, one host of this species, there is a wide degree of culture types ranging from lack of aerial mycelium to an abundance of such a mycelium. The pycnidia in the two cultures assigned to this species are

Table 2. Mold plate counts, in colonies per ml.-sample.

Date of collection	*Sample number*	*Number of colonies*	
		Pond	*Soil*
August, 1957	5	5	4,000
September, 1957	1	3	3,100
	2	6	9,400
	3	11	4,000
	4	2	15,000
	5	20	48,000
	6	1	34,000
June, 1958	1	10	60,000
	2	16	28,000
	3	10	200,000
	4	18	66,000
	5	1	14,000
	6	1	3,000
	7	1	1,600
	8	1	320
	9	1	2,200,000
	10	1	5,800

thick walled, embedded in a dense grey to brown mycelium, and produce hyaline bacillar pycnidia-spores 5.5 x 2 μ. Isolated from pond water collected in August 1957 (9), and from water from Pond No. 7, June 1958 (56).

Phoma spp. Two cultures which differ from each other, contain pycnidia-like structures which are black, thick walled, and embedded in a dark brown mycelium. No spores had been produced on either strain after 2½ months. Isolated from Ponds No. 2 (38b) and 4 (47), June 1958.

Cultures isolated from water in Pond No. 6, and from Soils No. 1, 3, 6, and 7, did not produce growth at Cincinnati or grew so slowly that no attempt was made to reach a decision as to their identification. It is quite possible that among these cultures are species adapted to low-temperature habitats (54, 61a, 62a, 66, 75, 77).

One isolate of the red yeast *Rhodotorula glutinis* (in the broad sense) was obtained from pond water in August 1957 (10); and 11 isolates (25, 26, 27, 28, 29, 48, 49, 50, 53, 71, 72) of white yeasts were made from water in Ponds No. 3 and 5, and Soils No. 1 and 3, September 1957; and from water from Ponds No. 4 and 6, and from Soil No. 4, June 1958. Identifications of these yeasts are incomplete.

Assistance in identification of cultures has been furnished for Mucoraceae by C. W. Hesseltine, Peoria, Illinois; for *Penicillium* by Dorothy Fennell, Natick, Massachusetts; and for Heasts by H. J. Phaff, Davis, California. Numerals in parentheses are AHRC culture numbers assigned to the strains isolated.

This set of isolations from soil and water samples from tundra habitats indicates that even in the presence of permafrost the fungi take an active part in the degradation of organic matter deposited by the higher plants, lichens, and Bryophytes in the surface layers that thaw during the brief summer. That this should be true is not surprising in view of Féher's work with soil organisms. In 1933 he reported isolating from soil samples obtained from 66° 50′N. to 69° 30′N. In Europe 39 species of soil fungi including some species and all genera listed above. There seems to be no doubt that, with refinement of techniques and development of specific interests, other species can be added to the list.

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[2]Savile, D. B. O., 1959. The botany of Somerset Island, District of Franklin. Can. J. Bot. 37:959-1002.

[3]Kelsall, J. P., 1959. A poisonous fungus in the Northwest Territories. Can. Field. Nat. 73:130.

[4]Favre, J., 1955. Les champignons supérieurs de la zone alpine du Parc National Suisse. Part 5, N.S. 33:1-212.

[5]Williamson, E. S. L., 1957. Ecological distribution of birds in the Napaskiak area of the Kaskokwim River Delta, Alaska. The Condor 59:317-338.

[6]Cash, Edith, 1953. Fungi of Alaska. Pl. Dis. Reptr., Suppl., 219:1-70.

[7]Cooke, W. B., and D. B. Lawrence, 1959. Soil mold fungi isolated from recently glaciated soils in Southeastern Alaska. Jour. Ecol. 47:529-549.

[8]Sprague, R., 1955. Check list of the fungi of the Glacier Bay National Monument, Alaska. Washington State College Research Studies, Pullman, 23:202-224.

[9]Sprague, R., and D. B. Lawrence, 1959, 1960. The fungi on deglaciated terrain of known age. Washington State University Research Studies, Pullman. 27:111-128, 224-229; 28: (in press).

Application for the position of Executive Director of the Boreal Institute of the University of Alberta.

The Boreal Institute invites applications for the above position.

The Executive Director will be a full-time appointee who will aid the Directorate in planning the activities of the Institute, implement its decisions, administer its daily operations, solicit funds for its advancement and publicize its activities and accomplishments.

Applicants must be interested in the North, have administrative ability, ability to deal with the public and be fluent in written and spoken English. They should be willing and able to travel in the North and have some northern experience.

Applications must include a complete account of experience and educational background, references, other pertinent data, and a recent photograph.

The appointment will be effective April 1, 1961. Salary will depend upon qualifications. Applications should reach the Boreal Institute, University of Alberta, Edmonton, Alberta, Canada, before February 1, 1961. They will be held in confidence if desired.

INSTITUTE NEWS

The Arctic Institute Devon Island Expedition 1960.

The Arctic Institute of North America, having decided that scientific research in the Arctic could be significantly advanced by establishing permanent base facilities at certain key localities and conducting long term, detailed, integrated observations in several scientific fields, initiated the Devon Island Expedition 1960-1963, the objectives of which are:

(1) A study of the relationships between the marine environment (Jones Sound), the Devon Island Ice Cap, and the atmosphere, with special regard to heat budget, energy flow, and moisture transfer.

(2) A detailed investigation of the oceanography and marine biology of Jones Sound.

(3) A detailed investigation of the archaeology, biology, and geology of Devon Island, together with other studies that may provide auxiliary information for objective (1).

The main purpose of the 1960 expedition was to establish facilities and cache