also in 1973, the air strip contained numerous wet areas. Their main area of concentration was in the work area in front of the camp where there was continual movement of equipment. The repetitive application of pressure over an area rich in ground ice (such as by a fork-lift when unloading aircraft) has a "pumping" action whereby moisture is slowly forced to the surface. This constant agitation distributes the water throughout the mass, and the material becomes "quick" owing to the reduction of intergranular pore pressure.[5] This results in loss of cohesion, and the material becomes spongy and jelly-like when pressure is applied.

The practical significance of this brief investigation is that the wet spots will probably not increase in size or the surface deteriorate further, but in fact there should be an improvement. It appeared from discussion with camp managers on two islands that, after two or three summers of use of the surface and scraping, the wet spots dry out. The best approach to the use of these vegetated (and therefore ice-rich) non-sorted, patterned ground surfaces in the High Arctic is to clear the areas before thawing occurs in the spring, and if possible not to use them heavily during the first one or two summers. By the second or third summer much of the ground ice will have thawed, so there should be less chance of major problems with wet and soft spots — unless the summer is unusually wet, as it was in 1973.

ACKNOWLEDGEMENTS

We thank Panarctic Oils Ltd. and Sunoco for both logistic and camp support which made our study possible.

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The Use of APT Satellite Imagery in a Subarctic Airborne Oceanographic Survey

GENERAL

During an airborne oceanographic survey of ice conditions in the east Greenland driftstream in April 1972, earth-oriented satellite photographs were received aboard the research aircraft *Arctic Fox* of the U.S. Naval Oceanographic Office. These photographs, broadcast directly from the satellites *Nimbus 4* and *ESSA 8* (Environmental Survey Satellite) were received by means of an APT (automatic picture transmission) satellite receiver station[1] equipped with a specially-modified airborne satellite communication antenna.

The satellite photographs showed the ice and cloud conditions for the Greenland Sea as they existed during each flight. This information was used both as a planning and operational aid during the survey and as a post-survey data source of ice and cloud conditions.

SATELLITE AND APT STATION DESCRIPTION

The satellites used during the experiment were in polar orbits. This north-south orientation of orbit created an overlap between each consecutive orbit that increased towards the poles. In the latitudes of the study area, the overlap in the paths of each consecutive orbit was approximately 50 per cent. Thus, it was possible during the experiment to use the early morning satellite photographs in the pre-flight planning sessions to examine the general conditions of ice distribution and weather over the entire Greenland Sea, and to locate regions within the study area having the specific ice and cloud conditions required for that day's survey. Photographs obtained late in the morning and early in the afternoon were used to delineate the exact extent of the ice and cloud conditions in the chosen survey region. As mentioned earlier, these later photographs were retained as a data source of the survey region's ice and cloud conditions.

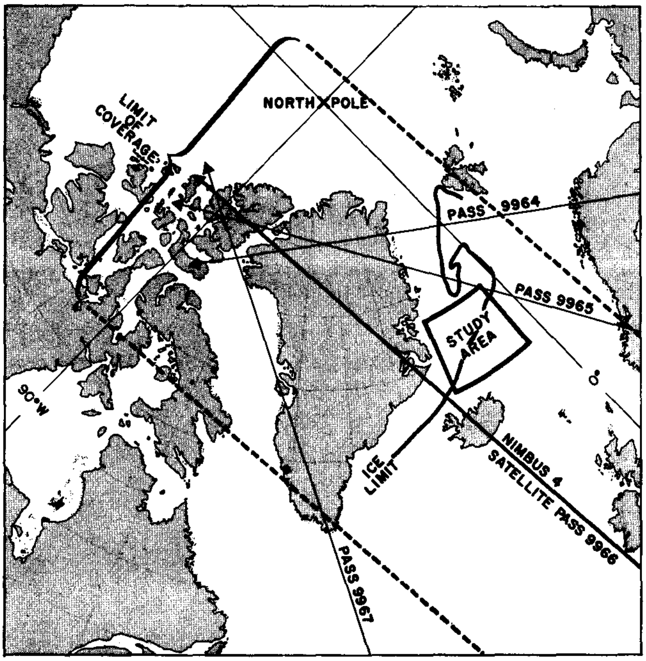

FIG. 1. Coverage of survey area by satellite *Nimbus 4* on 19 April 1972.

In addition to the boundaries between consecutive orbits, there was a 50 per cent overlap between the areas covered by successive photographs obtained from the satellites. This overlap made possible almost continuous examination of the Greenland Sea from the time of the first satellite orbit of the day to the last. Fig. 1 demonstrates the overlap between consecutive orbits of *Nimbus 4*. In the figure, the first orbit (9964) occurred at 0750 hours Greenwich Mean Time, and the last orbit (9967) occurred at 1307 hours.

Nimbus 4, operating at an altitude of approximately 1100 kilometres and using a camera with a light-differentiating aperture, provided early and late morning photographs of ice and cloud conditions. *ESSA 8,* operating at a higher altitude (approximately 1400 kilometres) and using a fixed-aperture camera, provided late morning and early afternoon photographs. The low altitude of *Nimbus 4* and the ability of this spacecraft's camera to continually adjust to the low-light condition of the northern latitudes during April resulted in its providing superior photographs in comparison to those of *ESSA 8.* Details are available of the orbits and the sensors aboard these satellites.[2,3]

The airborne APT field station used aboard the *Arctic Fox* was portable and relatively inexpensive in comparison to the larger, permanent ground APT stations operated by the U.S. Weather Service. The station consisted of a weather satellite photographic receiver with polaroid camera pack of the Electro-Mechanical Research Corporation, a Roberts tape recorder, and a specially-modified Dorne and Margolin airborne satellite communication antenna. The antenna, originally constructed for ground-satellite-aircraft voice communications (using the Applications Technology satellites) had been electronically retuned to receive the analogue data broadcast from *Nimbus 4* and *ESSA 8.*

Recording the satellite data as they were received by the APT station allowed the aircraft scientists to enlarge selected portions of the photographs by replaying the data tape through special circuitry in the APT receiver. An example of the photographs received aboard the *Arctic Fox* from *Nimbus 4,* as well as an enlargement of a portion of the photograph, is shown in Fig. 2. The enlargement was made aboard the *Arctic Fox* during its survey flight over the ice on 19 April.

The quality of reception by the APT station seemed unaffected by the aircraft's orientation or noise (the *Arctic Fox* was a four-engine Lockheed Super Constellation, C-121). The best data reception, however, occurred during flight, as regional electrical noises and VHF radio traffic caused occasional interference while the aircraft was on

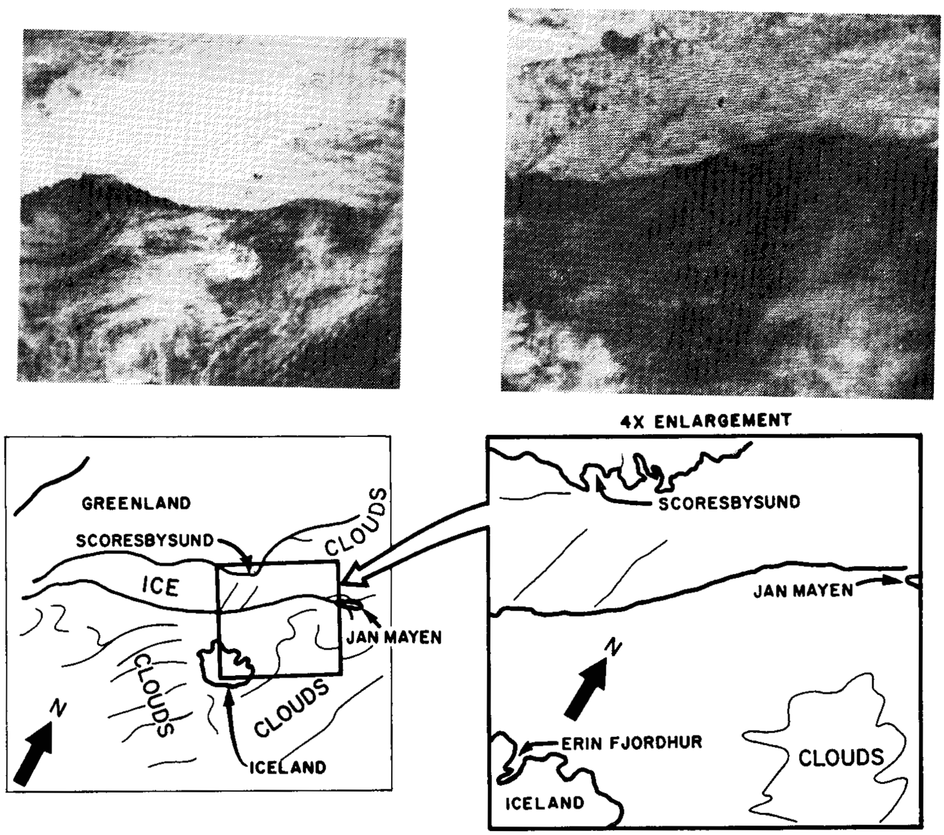

FIG. 2. Photograph by satellite imagery of survey area, with enlargement, taken during *Nimbus 4* orbit no. 9966 on 19 April 1972.

the ground. At these times, the previous or succeeding photograph usually repeated enough of the interference-marred photograph for no information to be lost.

THE SURVEY

The region examined during the survey by the *Arctic Fox* was the ice-entrained area in the east Greenland drift-stream bounded by the latitudes 68° and 73°N., and the longitudes 5° and 20°W.[4,5] Altogether, six flights were made over the ice during the period 16-26 April. These flights, averaging 10 hours each, originated from Keflavik in Iceland, Trondheim and Bödo in Norway, and Lossiemouth in Scotland. Environmental parameters were measured by means of remote sensors mounted on the aircraft and air-droppable oceanographic instruments.[4,6] The experimental sites were located in the vicinity of the ice-water boundary, where the weather is generally highly variable and cloud conditions can change significantly in a period of a few hours.

A necessary environmental condition for the successful utilization of the aircraft's remote sensing equipment under these conditions is good visibility. By using the satellite photographs provided by the APT station, essentially no flight time was lost searching for cloud-free regions suitable for operations.

In addition to cloud-free regions, each day's survey required specific ice conditions. On some flights the need was for a packed, well-defined ice edge, and on others for loose, wind-dispersed ice conditions. Again, the photographs obtained by the *Arctic Fox* APT station showed the ice conditions in the cloud-free areas, so that a selection could be made of a region with the desired ice conditions.

Finally, the weather conditions to and from the survey region, and the amount of operating time allowable in the region because of changing weather conditions, was determined by the cloud distribution shown in the almost-continuous sequence of APT photographs.

CONCLUSION

The satellite APT photographs received during this survey were the first operationally received aboard an aircraft. Their successful utilization during the survey demonstrated that satellite photographs provided by an airborne APT station can be useful in the planning and operation of a subarctic airborne oceanographic survey. In addition, the experiment showed that the photographs collected during the survey can provide valuable data on the regional and local ice and weather conditions for use in the post-survey analysis.

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A Microbiological Study of some Lake Waters and Sediments from the Mackenzie Valley with Special Reference to Cytophagas

INTRODUCTION

The microbial population of arctic lakes has not yet been thoroughly investigated. A few studies have established the presence of cold-tolerant[1] as well as mesophilic and thermophilic bacteria[2,3]. Bunt[1] has recently reviewed the productivity of both aquatic and permafrost environments in polar regions, and although some work has been achieved with green and blue-green algae few bacteriological data are available. Considerably more microbiological work has been done on permafrost soils than on the associated arctic lakes[4].

This paper is a report on the microbial flora of the waters and sediments of five lakes from the Canadian Subarctic, with special emphasis on the genus *Cytophaga*. The cytophagas are long, thin rods which are capable of flexing in liquids and of gliding motility on solid surfaces. They are important in the degradation and recycling of many relatively resistant, macromolecular polysaccharides and proteins such as cellulose, chitin, agar and keratin which occur as structural or storage residues of "higher" plants and animals in the natural environment.

MATERIALS AND METHODS

The samples were collected aseptically during the summer of 1971, flown to Edmonton and stored at 4°C until processed, within two days of sampling time. Three media which allow good growth of cytophagas[5] were used: Cook's cytophaga agar (C.C.A.), tryptone yeast acetate (T.Y.A.), and skim milk acetate (S.M.A.). Duplicate sets of plates were inoculated with dilutions of each sample and incubated at about 25°C for 11 days, and at 10°C for 18 days. General estimations were made of numbers and types of bacteria present. Interesting organisms, including possible cytophagas, were picked and purified for further work. An exhaustive search of one sample (4810 water) was made for possible cytophagas.

Tests, which were carried out at the isolation temperature of each organism (10° or 25°C), were as follows: C.C.A. — growth, spreading, colour, length, width, shape and motility were described at 3-4 days (25°C) or 5-6 days (10°C); S.M.A. — proteolysis (clearing) and silkiness of the liquid culture were noted at 2, 3 and 6 days and length, width, shape, flexing and motility observations were made at 10-14 hrs. and 2 days (25°C) or 24-42 hrs. and 5 days (10°C); S.M.A. — growth at 5° and 30°C, and proteolysis were noted at 6 days. Gram stains and Munsell colour determinations[6,7] were made at 4 days.

Organisms were placed in the genus *Cytophaga* when they possessed at least five of the following seven characteristics: cells $<0.5\mu M$ wide, $>6\mu M$ long, flexing, silky when culture gently shaken, proteolytic, Munsell colour