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INSTITUTE OF CURRENT WORLD AFFAIRS

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The Arctic Institute  
Greenland Expedition  
1958: Review

c/o Scott Polar Research Institute  
Lensfield Road  
Cambridge  
England  
9 September 1958

Mr. Walter S. Rogers  
Institute of Current World Affairs  
522 Fifth Avenue  
New York 36, New York

Dear Mr. Rogers,

The completion of the last gas-in-ice dating sample on 14 August marked the effective end of the field phase of the Arctic Institute Greenland Expedition 1958. After two days spent in disassembling, packing and stowing the various equipment, M/S Rundbø departed from Prins Christians Sund in southern Greenland and began her seven day rolling, pitching passage back across the North Atlantic to her home port of Alesund. With the dismantling of the laboratory which had been erected on deck (and appropriately named Boblebua, or bubble house), Rundbø regained the normal appearance of a Norwegian seal hunter after a summer which was, for ship, captain, and crew, quite unusual. In less than two months' operations (and after handling more than two hundred tons of ice on deck) eleven dating samples were obtained, considerably exceeding the highest expectations before the cruise began. And, had there been reason for doing so, additional samples could have been procured during that period. Into these eleven samples went about 125 tons of ice actually melted (in 150-lb increments), the carbon from which, extracted from the CO<sub>2</sub> of the entrapped gases, is now contained in eleven small glass ampules.

Rundbø's first Greenland stop, after her rolling-pitching crossing from Norway, was the international fishing port of Faeringehavn, where provisions, fuel, and water were taken on for the summer. Run by a Norwegian-Danish-Faeroese company, Nordafars, Faeringehavn serves as a base of operations for fishing vessels of all nationalities (and of all shapes and sizes) working the fishing banks of west Greenland. In operation from mid-May through the first of October, Nordafars buys from the ships their catches of fish, and sells them fuel and supplies, including the tons of salt needed to preserve the fish. Ships were tied up two and three abreast at the dock, which is dominated by a storage warehouse for the salted fish, a refrigerated warehouse for provisions, and a large bulk-salt shed. Further inland are barracks for the company workmen, shops, and a recreation building (canteen and movie hall). Faeringehavn is a strictly-business port, without a bar.

After leaving Faeringehavn, a brief stop was made at Godthaab to clear with the Danish authorities and make our official entry into Greenland. The administrative center of Greenland and its largest "city," Godthaab has a population of about three thousand, of whom five hundred are Danes. When the necessary formalities were completed, Rundbø proceeded north to Jakobshavn to begin the work of the expedition.

Jakobshavns Isfjord in one of the five great "Rivers of Ice" from the Greenland ice cap, ice streams flowing within the main mass of ice, all highly productive and all prime targets for the expedition. A combination trial run on the equipment and procurement of a dating sample was made upon arrival at Jakobshavn, which showed all to be working as planned. With the completion of this, a small berg from off Jakobshavns Isbanken was selected for a second sample. The ship first tied up alongside the berg, which was flat-topped and only about 4-5 feet out of the water, and ice was taken directly aboard. The captain later decided, however, that it was not safe to keep the ship tied up to the berg, so it was cast loose and pieces were broken off by ramming, these then being hoisted on deck with winch and cargo net. With some modifications, this was the system used for the rest of the summer.

Following this sample, we proceeded north to Eqip Sermia, a small, relatively inactive glacier at the northern end of Ata Sund. This was the site of several years post-war work by Paul-Emile Victor's Expeditions Polaires Francaises. Once finished here, an attempt was made to reach Torssukatak, another of the great "Rivers of Ice," located to the west of Eqip Sermia. However, the fjord was too heavily packed with ice to permit the ship to reach the desired objective. Instead, a sample was taken at Kangilermgata Sermia, more productive but less well known next door neighbor of Eqip Sermia.

The next goal was Grand Qarajaq, a third "River of Ice." Here again ice prevented the desired penetration of the fjord, however the ship could easily have gone a considerable distance further than the captain was willing to take her. Though familiar with the pack ice of east Greenland (Rundby was one of the most successful sealers this past spring), he was evidently unfamiliar with navigation among icebergs, and in general displayed a marked over-caution in the presence of large bergs, and in proceeding down fjords where such were present, almost irrespective of how much open water lay among them. However, some further penetration was made by motorboat and a bergy bit towed back to the ship. Unfortunately, there was no way of telling whether this ice came from Grand or Little Qarajaq, as both glaciers discharge into the same fjord. Further penetration by the ship might have been possible to the point where this could have been determined.

Working on northward, another sample was obtained at Kangerdlugssuaq, future (1959) site for Victor's Expedition Glaciologique Internationale au Groenland, followed by another from ice freshly calved from a large berg aground in the entrance of Karrats Isfjord. Two glaciers discharge into Karrats, Rinks and Umiamako; the former, a "River of Ice," was the desired target. Again, the over-caution of the captain kept the ship from a possible penetration of the fjord to a point where one could have been sure of obtaining ice from Rinks. However, the known characteristics of the output of these two glaciers make it almost certain that the berg sampled was a Rinks offspring.

As the summer operations progressed, various improvements in equipment and technique were made, in making every possible assurance against leaks in the vacuum system which could have permitted air to enter and in

simplifying and speeding up the processes of ice procurement and handling. Wherever possible, the ice was obtained from fresh calvings, the motorboat being sent out to help maneuver relatively small pieces alongside the ship. These were then cut up, if necessary, with a steam "knife" into pieces small enough to be hoisted on deck. This process proved quite efficient, and the deck could be loaded with ice in a very short time.

After completion of the Rinks sample, one was taken at Ingnerit, another small Disko Bay glacier, before proceeding on to Upernaviks Isfjord and the last "River of Ice." Here the fjord was completely covered with brash and sea ice, through which Rundbø plowed until it became expedient to duck into a small haven south of the fjord proper. In addition to the dating sample, three days continuous time-lapse movies (at one frame per minute) were taken looking across the fjord. The same had earlier been done at Qarajaqs Isfjord, and it is hoped that the results may open up possibilities for the use of time-lapse photography in the study of ice movement in fjords and the disintegration of icebergs.

Again heading northward, with a brief delay when Rundbø hung up on a previously-unknown submerged rock, southern Melville Bay was entered and ice obtained from a very large berg off the Kjaers-Hayes glacier complex. This was the northern limit of the summers work, and from Melville Bay the ship proceeded to Godhavn, at the southern tip of Disko Island.

Then going around to the northeastern side of the island, three of us went ashore for two days to try to obtain snow samples from above the firn line on the ice cap, i.e. above an elevation of about 4500 feet, for oxygen isotope analyses. While the map seemed to indicate two good access valleys through the fringe of coastal mountains, neither provided, in fact, an easy route. Here again there was an indication of what I have termed the Norwegian over-caution in the face of the unfamiliar, which led to our turning away from the first valley approached. However, ice samples were obtained from a small local snow field at about a 2000 foot elevation, and it is hoped that these will serve to show the annual variation in the ratios of the isotopes  $O^{16}$  and  $O^{18}$ .

The last dating sample was obtained at Brede Fjord in southern Greenland, providing greater geographical spread among the samples. Following this, preparations for the homeward journey began.

While the main emphasis of the expedition was on the gas inclusions in glacier ice, that was by no means the only area of investigation. In addition to the time-lapse photography already mentioned, CDR Nutt made some thirty hydrographic stations. These were largely exploratory in nature, to indicate possibilities and problems for systematic, detailed work in the future. In addition to the usual hydrographic measurements, the amounts of oxygen and nitrogen dissolved in the sea water, at various depths, were measured for several stations.

Supplementing the gas dating samples and analyses of gas composition, Dr. Scholander developed a method for accurately measuring the pressure of the gas bubbles in the ice. This is, as far as we know, the first time

that these measurements have been made with any degree of accuracy. The measurements showed frequent pressures from 15 to 15 atmospheres, with an observed maximum pressure of 20 atmospheres. The technique, being simple and easily done in the field, should hold great promise for future glaciological work.

The major portion of the results of the expedition's work will be known only after the completion of further laboratory analyses such as the radio-carbon dating, oxygen isotope determinations, and additional gas composition analyses. One basic result is readily apparent, however, in that in none of the samples was there found any gas inclusion identifiable as ancient atmosphere. While in all cases the gas composition closely approximated that of air, there were in each case variations in the composition, indicating modification of the gas inclusions through contamination by melt water during the formation of the ice or during its exodus from the interior to the sea.

The results of the radio carbon dating will perhaps be the most interesting; estimates of the age of the Greenland ice cap range from ten thousand to over one hundred thousand years. Some questions will be answered, many will remain for the present unanswered, and still others will be raised as a result of the work done on this expedition. It is not unlikely, perhaps, that in the relatively near future this same technique will be applied to Antarctic ice in the search for ancient atmosphere.

If this is done, one would, ideally, make some changes. First and foremost, a larger ship would be needed, together with an expanded scientific staff. A glaciologist would be a most desirable addition, as well as a marine biologist, to take fullest advantage of occurring opportunities. More laboratory space, equipment to melt the "gas inclusion" ice more rapidly, provision to protect this ice from surface melt once hauled aboard, more complete oceanographic equipment - all these would be functions of an expanded expedition, which an Antarctic venture would by definition be.

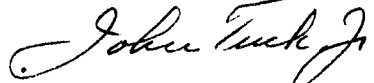
One would also desire greater control of the operation of the ship, and to have as its captain a man thoroughly familiar with the conditions to be encountered. The "over-caution" in the face of the unfamiliar which was evidenced during the summer has been mentioned; at the other end of the scale there was displayed by the crew an almost reckless lack of caution in situations with which they were familiar. Some of the expedition personnel will agree with this observation, others will not; those in the former category were often highly puzzled at, and occasionally somewhat annoyed by the paradox of extreme overcaution on the one hand and almost complete recklessness on the other.

This does not constitute condemnation of the captain or crew, but rather points to limitations observed upon occasion. The cooperation received from the crew was in general outstanding, and it was they, in fact,

who handled the lions share of the often-onerous task of getting the ice on board.

In mentioning problems one must be careful not to over-emphasize them; they are, to a greater or lesser extent, and for many varying reasons, part and parcel of any expedition. Ours, happily, were minor, and the expedition enjoyed a great measure of success.

Very sincerely,

A handwritten signature in cursive script that reads "John Tuck, Jr." with a period at the end.

John Tuck, Jr.

Received New York September 17, 1958