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ANDY HEIBERG (1938–2021)

Early one morning in April 2013, it was a harsh surprise when a Russian swung open the door to our tent on the sea ice at the North Pole and shouted that the ice around us was breaking up and we should get up and get out fast. It was a surprise, but not a totally unexpected one for Andy Heiberg. Andy had experienced such events and the recovery from them many times before, and he had seen that every year over the previous ten the North Pole “Barneo” camp had been built on successively thinner ice more prone to break-up. In fact this break-up could be looked upon as the sign of the end of an era of sea ice research logistics that Andy had been key in developing over nearly 50 years, a time during which the average thickness of Arctic sea ice and the late summer ice extent each declined by nearly half. Just as the old, thick ice is disappearing, the sea ice research community lost a great friend and a one of its key figures when Andy passed away at home with his family on 17 February 2021 after a short struggle with pancreatic cancer.

Andy was an internationally known expert in operations and logistics for scientific fieldwork on sea ice. He was born Andreas Heiberg on 12 May 1938 and raised in Figgjo, Norway, before moving to Zurich, Switzerland to earn a Master’s degree in Aeronautical Engineering from the prestigious ETH Zurich (Eidgenössische Technische Hochschule Zürich). From university Andy was recruited by Boeing in 1967 and moved to Seattle, Washington, originally to work on the Super Sonic Transport program. Perhaps as a foretelling of his future, at Boeing he designed and patented devices to allow Boeing 737s to be operated off gravel runways in Alaska and other remote locations. In 1971, Andy began working at the Arctic Ice Dynamic Joint Experiment (AIDJEX) office at the University of Washington. This was in time for the 1972 AIDJEX pilot experiment, and Andy was put in charge of the logistics for the AIDJEX Lead Experiment in 1974 working out of the Naval Arctic Research Laboratory (NARL) in Barrow, Alaska. During the 1975–76 AIDJEX Main Experiment, Andy moved to NARL with his family to coordinate the day-to-day logistics operations. These logistics kept dozens of scientists working successfully at up to four ice camps in the Beaufort Sea from spring 1975 through the Arctic winter nights to the fall of 1976. Operations included multiple C-130 supply flights to runways carved out of the sea ice by the logistics team, handling the break-up of the main camp in the fall of 1975, and the relocation of the science party. The end result of AIDJEX was an unprecedented leap in our understanding of how sea ice deforms and moves in response to the atmosphere and ocean; knowledge that forms the basis for sea ice models we still use today.

When AIDJEX ended, the team that had been assembled, including Andy, was in demand for continued research on Arctic sea ice, and the team consequently founded the Polar Science Center (PSC). In the late 1970s, the U.S. Office of Naval Research (ONR) High Latitude Program tapped



Andy Heiberg in Longyearbyen, Svalbard, Norway with his fiber box packing for home (Photo taken by Frederck Vivier).

Andy and his PSC logistics team to carry out a sequence of experiments focused variously on air-sea-ice interaction and under-ice acoustics. These experiments included four “Fram” ice camps in the springs of 1979 to 1982 and the Eurasian Basin Experiment in the spring of 1981, all of which were aircraft operations staged from Station Nord, Greenland. In 1983 and 1984, Andy coordinated the logistics for the multi-ship, international Marginal Ice Zone Experiments (MIZEX) in the marginal ice zones of Fram Strait and East Greenland. In addition to his technical talents, Andy’s ability to speak English, Norwegian, and German made him uniquely qualified for this job.

Around the time of MIZEX, the PSC became part of the Applied Physics Laboratory at the University of Washington. ONR projects continued with the 1985 Arctic Internal Wave Experiment in the Beaufort Sea, for which Andy coordinated logistics out of Deadhorse, Alaska. It was marked by the introduction of several renowned open ocean internal wave experts to life on the ice and the construction, by hand, of perhaps the last sea ice runway for C-130 aircraft.

In the springs of 1988 and 1990, Andy worked out of Canadian Forces Station (CFS) Alert to coordinate logistics for the joint U.S. Naval Ocean Research and

Development Activity (NORDA) and Canadian Defense Research Establishment Pacific (DREP) ICESHELF project. In between Alert visits from fall 1988 through the spring of 1989, it was back to the Eurasian Basin with the ONR-sponsored Coordinated Eastern Arctic Experiment (CEAREX). Continuing the AIWEX trend, CEAREX included many physical oceanographers formerly from outside the polar research community, and Andy showed his expertise in ship and ice camp logistics coordination because CEAREX involved both a 1988–89 winter drift ship component and two spring 1989 ice camps supported by aircraft out of Longyearbyen, Svalbard, Norway.

In 1991 and 1992, Andy guided the logistics for the pilot and main LeadEx lead experiments. LeadEx was operationally and logistically complicated in the sense that it required staging two helicopters to transport multiple huts from a central camp to newly formed leads in a matter of a few hours, essentially multiple mini-camps staged from a central base camp. At the same time Andy advised on the ice camp logistics of the 1992 US-Russian joint Ice Station Weddell in the Weddell Sea. The Sea Ice Mechanics Initiative ice camp followed these in fall 1994 and spring 1995.

Then in 1995–96, planning started for the Surface Heat Budget of the Arctic Ocean (SHEBA) yearlong experiment to be conducted in 1997–98. Andy's role in planning SHEBA was absolutely pivotal because we essentially had no idea how we were going to support a year-round operation on sea ice that was already growing thinner due to climate change. Andy investigated various options including ice camps, ships from various nations, and even a specially fitted barge. Significantly, based on his assessments, the decision was made to use the Canadian Coast Guard (CCG) icebreaker *Des Groseilliers* with transport to and from the ship by the CCG *Louis St Laurent*, United States Coast Guard icebreakers *Polar Sea* and *Polar Star*, and in winter and spring by Twin Otter aircraft. Again Andy's logistics successfully introduced many new young scientists to working on sea ice, and SHEBA produced a quantum step in our understanding of air-sea-ice interaction.

From 2000 to 2015, Andy did the logistics and operations for the North Pole Environmental Observatory (NPEO). NPEO was a virtual observatory meant to track atmosphere, ice, and ocean changes at one of the remotest places on Earth. The project involved annual deployments to camps near the North Pole by aircraft including an airborne hydrographic survey, deployment of automated drifting buoys, and service of a 4000 m oceanographic mooring at the North Pole. It included an international cast of investigators, support through Alert, Canada and Longyearbyen, Svalbard, Norway, and use of the Russian Barneo base camp where the aforementioned break-up occurred. Andy also returned to working at CFS Alert, where while renewing old friendships, he staged the Switchyard Program, a NPEO spin-off designed to measure ice and ocean properties between this northern-most

permanent human outpost and the North Pole. Year after year, in the face of changing ice conditions and changes in support companies, Andy was able to get NPEO and Switchyard investigators into the field as far as the North Pole and bring back vital data. These data are still giving us insights into interannual to decadal-scale changes in the Arctic Ocean.

Andy's contributions to our science are widely recognized. Many investigators express how often he got them out of a tight spot or had an answer for a seemingly impossible problem. Most of all we have to marvel at how successful his operations always were. Considering the challenging, often dangerous, and changing conditions and the relative inexperience of many of the hundreds of scientists he supported, it is remarkable that Andy brought us all home alive and with very few significant injuries. In 1992, Andy received a Meritorious Public Service Award from the Office of the Chief of Naval Research in honor of 20 years of service in support of Arctic research. In 1999, he received the National Science Foundation Arctic Service Award for his contributions to SHEBA.

There are several things beyond his intellect and technical knowledge that were the key to Andy's success. First was his humility in the face of the ever-changing environment, polar science, and technology. He often used to say that there are two kinds of Arctic experts, those who have been on one expedition and think they are an expert, and those who have been on more than 20 expeditions and maybe are experts but will never claim so. In planning and executing an operation, ego was not a factor with Andy. He never wanted to pretend he had all the answers ahead of time, but he was confident that he could find an answer for whatever nature threw at us, and he loved the challenge of coming up with new solutions.

Second, Andy prepared like crazy. His friendly, seemingly casual and easy-going personality may have hidden it, but he thought about everything long before anybody else did. For example, NPEO operations were typically in April every year, but as soon as one operation ended and the rest of us were thinking about summer vacations, Andy would start thinking about the next year's operation and begin contacting our Russian, Norwegian, and Canadian colleagues and contractors.

Finally, it was Andy's way with people all over the world that often made the impossible look easy. He enjoyed meeting new people and communicating with them, particularly in one of the languages he didn't know. He would delight in having to learn Russian using an impromptu sign language or pictographs scribbled on a napkin. He was always friendly and helpful to people new to polar research and exploration; it's been said that students always left conversations with Andy feeling a bit smarter, but with self-esteem perfectly intact. As a result, he had friendly contacts all over the polar-centered world. A standing claim was that the key to Andy's success was his Rolodex file, which was full of those contacts, his professional friends, and whenever we needed some help,

Andy knew somebody who could provide it. We can replace a Rolodex file. It is unfortunate to lose the person in Andy who could use one so well, especially at a time when once again we will need to find new ways to get out on the ice.

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