A Pictorial History of Polar Science and Technology, and Glacier Change, in Canada, from Axel Heiberg Island, Nunavut, Canada

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ABSTRACT

Changes in transportation, on the ground and in the air, and in instrumentation, have dramatically altered the nature of polar science in the half century since the McGill expeditions began research on Axel Heiberg Island, Nunavut, Canada, in 1959. These changes have intensified and extended research on glaciers and lakes and they have also produced marked changes in the way polar science is conducted and the nature, including gender balance, of people conducting the work. During the same period there have been equally dramatic changes in the glaciers of the region. These themes are presented through a series of annotated images.

Keywords: polar science, changes in all aspects of polar research including gender balance

INTRODUCTION

The McGill Arctic Research Station, in Expedition Fiord, Axel Heiberg Island, Nunavut, Canada, grew out of the McGill Axel Heiberg Expeditions of the 1950s and 60s. In succeeding decades, McGill, in cooperation with other organizations, including Trent University, ETH Zurich, Switzerland, the Canadian Space Agency, Wilfrid Laurier University, the Desert Institute of the University of Nevada and NASA, and most recently, the University of Ottawa, has developed a productive research base at a latitude (ca. 80°N) where global models suggest that global warming will be most pronounced. One of the research emphases throughout has been glacier science. Local glaciers now have some of the longest mass balance records in the polar regions.

The purpose of this note is to pictorially illustrate developments in polar science and technology during the years of McGill work on Axel Heiberg. The developments include the evolution from Expedition to Research Station, changes in communications and air and ground transportation, changes in the degree of automation of field instrumentation, the shift from air photos, through maps, to remotely sensed imagery (including satellite imagery), the evolution of a made-in-Canada science workforce including changes in the gender balance of that workforce, and dramatic change in the glaciers.

The McGill expeditions began in the earliest days of Polar Continental Shelf Project which itself has evolved into the Polar Continental Science Program (PCSP), Canada's Arctic science air support system. The PCSP has nurtured Axel Heiberg research, throughout its history.

The history of the McGill Arctic Station Is a microcosm of general change in research in the North in Canada.

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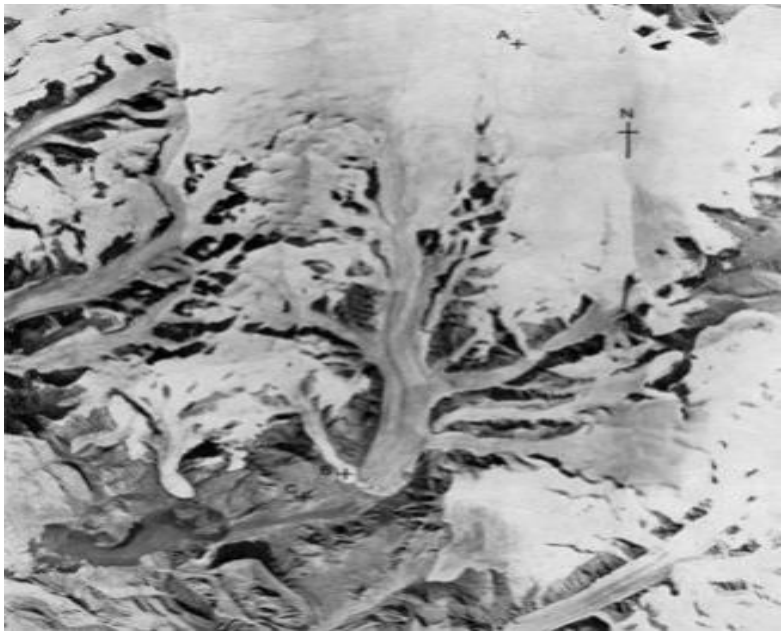
Figure 1. From Expedition to Research Station, the McGill Expeditions base, on Colour Lake on the western side of Axel Heiberg Island grew from a cluster of tents beside the lake to two prefabricated huts to modern stations of today. This site was selected in 1959 from a base camp, Wolf Camp, closer to the Arctic Ocean. This first camp was destroyed by wolves. Colour Lake and an adjacent air strip allowed air access. The development of this base has greatly simplified field work planning in the region over the years and has attracted researchers from many disciplines.



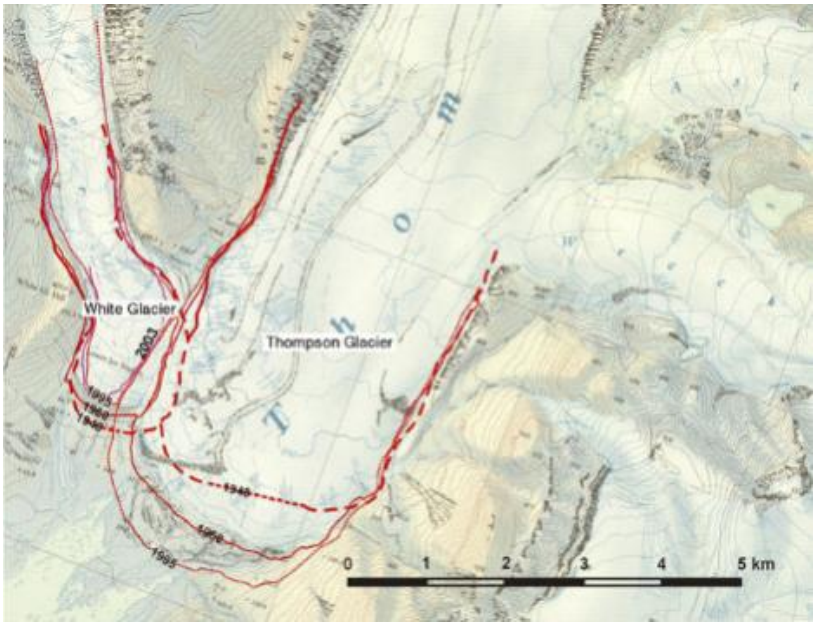


Figure 2. From air photos through maps to remotely-sensed imagery, the first image of Expedition Fiord and the White Glacier was an oblique air photo taken by the United States Air Force in 1948 (above left). Lacking maps the original expedition used mosaics made from vertical air photos taken in the late 1950's. In the 1960's topographic maps of various scales were made, including the one shown here depicting the terminus of White Glacier. Examples of modern imagery of the glacier are shown in Figure 6.

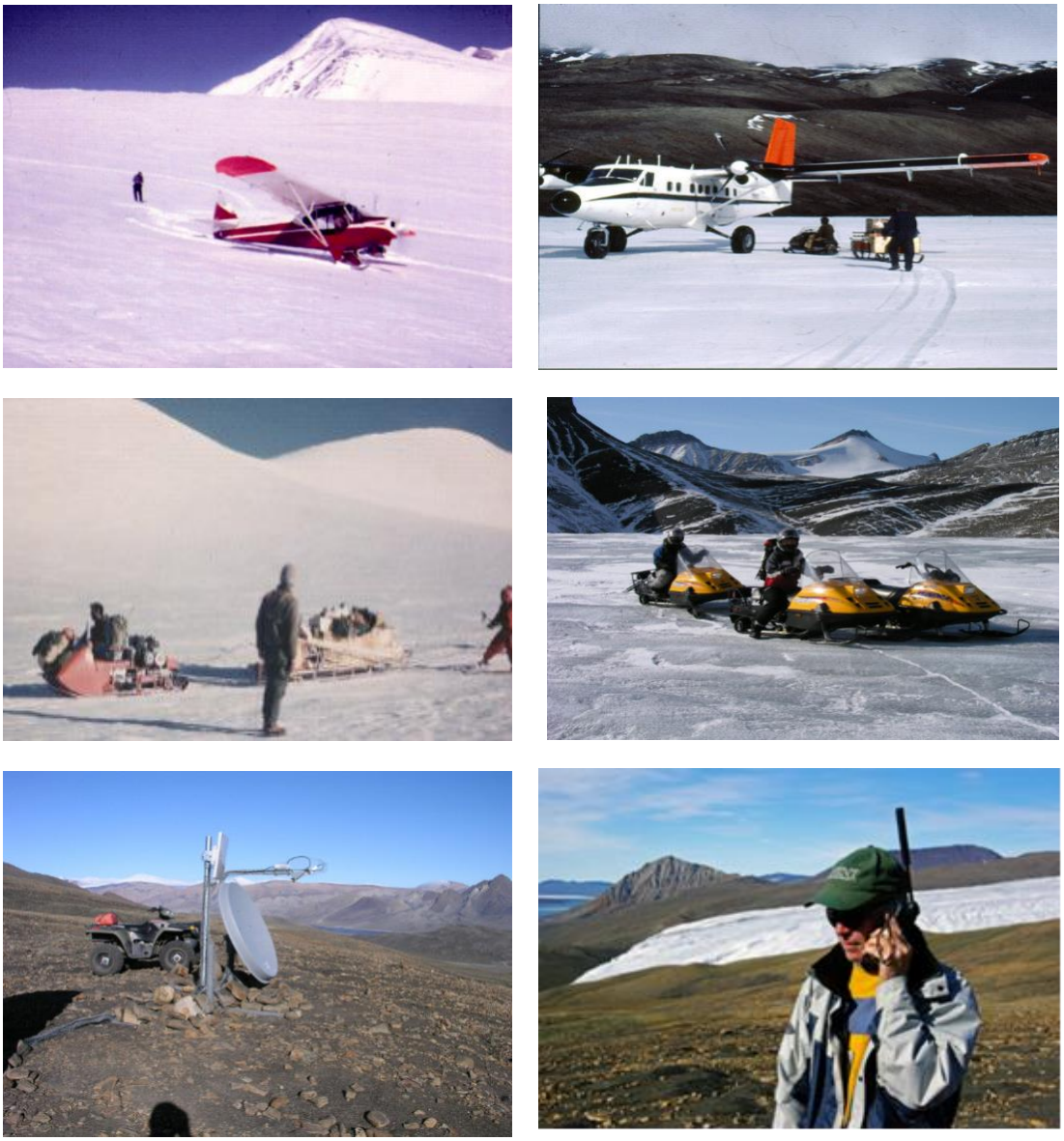


Figure 3. Transportation and communications in the early years was south to Resolute Bay and was by charter and military aircraft often with one or more extended stops en route. Radio communication from the field and 'southern' Resolute Bay was often 'down' for days at a time. Travel from Resolute to Axel Heiberg was by small aircraft such as single engine Piper Cubs equipped with skis (above, top, left) and D.H. Beavers. Over the years, radio communications improved, and commercial air service to Resolute began. Today Twin Otters (above, top right) chartered by PCSP took over flights to Expedition Fiord. On land, skis and then rear-engine motor toboggans (above, middle, left) were replaced by snowmobiles and ATV's of today. There was no radio communication with the south on Axel in 1959 but field and base radios (often receiving little but Moscow Molly) came in rapidly. Today satellite phones and even internet communication (above, bottom left and right) are in place in Expedition Fiord.

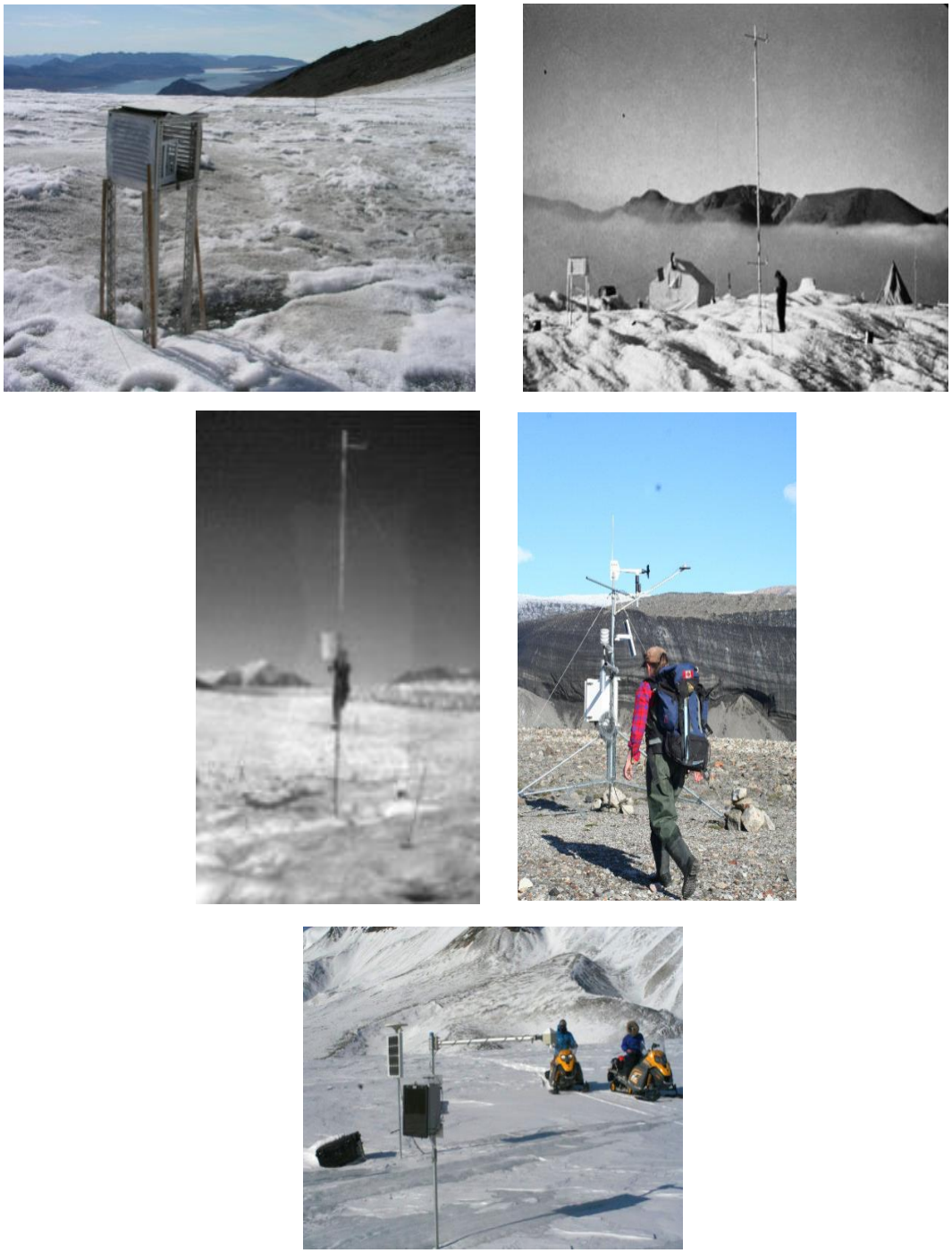


Figure 4. Changes in instrumentation. In the early 1960's the Lower Ice Station, on the tongue of the White Glacier (top right) was staffed throughout each 4-month summer season. This was a site for meteorological and englacial temperature monitoring. A few instruments were "automated" and were housed in a Stevenson Screen, such as hygro-thermographs (top, left). These instruments ran for seven days using a mechanical, clock-driven rotating drum with a chart affixed. Otherwise, staff had to get up every six hours or so to measure variables, including climbing the 10m mast (bottom, left). Early researchers experimented with automated remote stations with solar power and batteries but were largely unsuccessful. It was not until the early 1990's that the first year long series of temperatures and other variables were obtained using dataloggers (bottom, middle, right). It was then discovered that Axel site was 2°C warmer than the nearest weather station (Eureka on Ellesmere Island). Today remote stations dot the arctic and data are accessible from afar via satellite uplink.

Figure 5. Changes in the Expedition and later McGill Station workforce included gender balance. In the early year, fairly large groups, all men (top, left) spent four or five months each summer on Axel, operating largely manual equipment and slowly mapping the region especially its glaciers. The existence of a permanent facility and improvements in travel and communications, increasingly automated instrumentation made shorter visits possible and productive. The nature of the workforce gradually changed from all-male, senior researchers with few undergraduate students to mixed gender groups (bottom, left, right) with more young students. There was an emphasis on teaching as well as research. The increased involvement of Canadian universities in polar science resulted in more and more Canadians on Axel Heiberg. The McGill Arctic Research Station pioneered such changes.

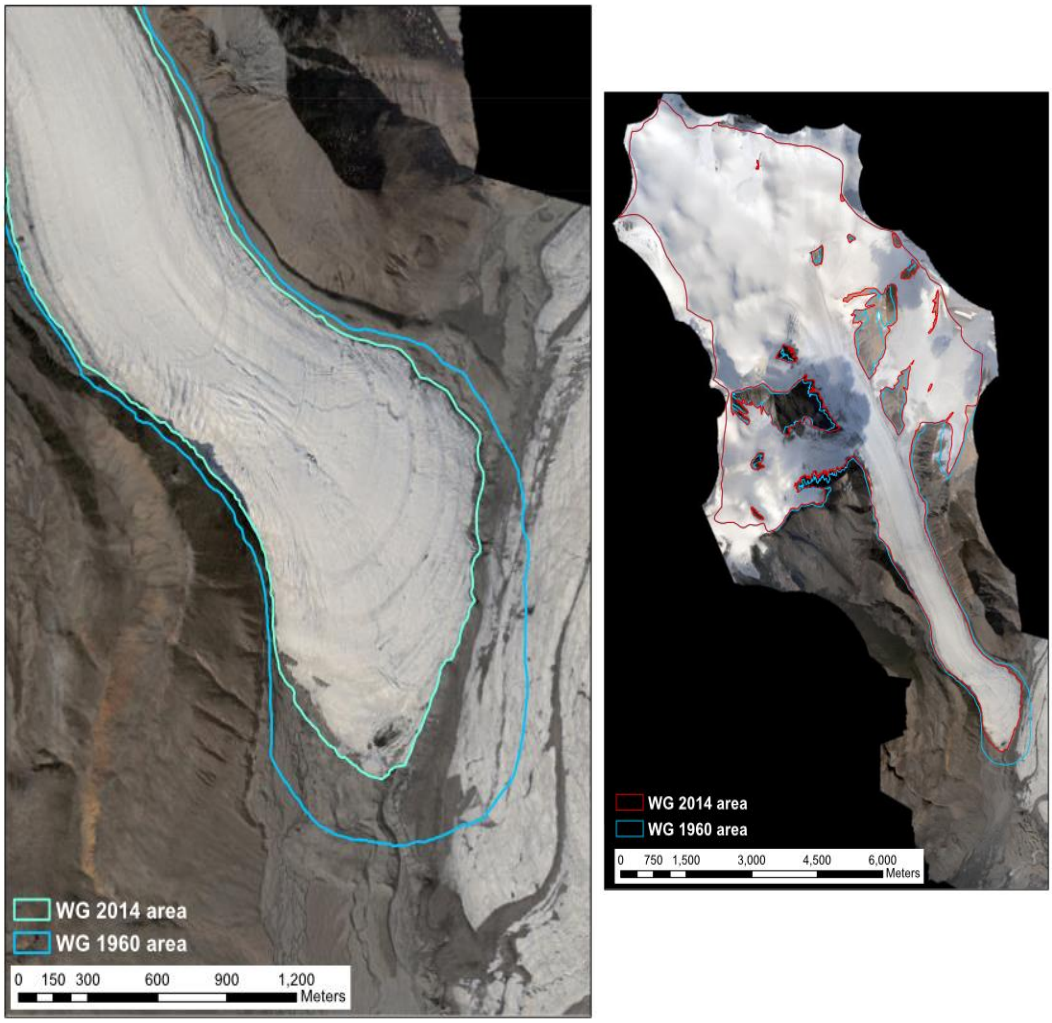


Figure 6. The glaciers on Axel Heiberg Island have shrunk since they were first mapped by the McGill Expeditions. White Glacier's mass balance measurement program extends from 1959-60 until today and data show that the decrease in volume has been especially pronounced since the 1970's. Monitoring such changes has been greatly simplified and improved with the introduction of GPS (Figure 4, bottom right). The images shown here, courtesy of Laura Thomson, University of Ottawa, illustrate these changes. The outer outline of the glacier terminus is the outline of the glacier has depicted on the 1960 map shown in Figure 2. The inner line the present day terminus. It is possible that the White Glacier will retreat to the point where it will become a tributary of its neighbour, the Thompson Glacier (although recent observations suggest that it is no longer advancing.

CONCLUSION

Even though glaciers are never static (they are continually moving and changing shape), the changes in them are almost imperceptible on a daily, monthly or even annual basis. Monitoring such changes requires careful work over many years. So it is with glacier science and the polar sciences in general. Change is continual but often unnoticed or taken for granted. The *Proceedings of the Eastern Snow Conference* for the decades covered by this article are full of reports on new instrumentation and methods. Some of these changes were successful and some not but over the years, perspectives changed as the technology changed. The people engaged in the work also changed, not simply in terms of the individuals involved but in the demographic and academic background of those engaged in the work.

This brief history of the work of the McGill Expeditions and McGill Arctic Research station is a vignette of changes in polar research over the decades. The early expeditions were leaders in their day, bringing Canadian universities into the difficult and sometimes dangerous study of Axel Heiberg Island. They pioneered changes in polar science in the universities of Canada and these changes then drove further changes in the high Arctic work. Trent University which took over much of the glacier work in the 1980s, did not exist when the expeditions (and the high Arctic glacier record) began. Today, the work is now being undertaken by the Laboratory for Cryospheric Research at the University of Ottawa by people greatly skilled in satellite and other remote sensing methods which did not exist when the Axel Heiberg expeditions were first launched.

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