Polar Lessons for Our International Polar Year (IPY, 2007-2009) from the International Geophysical Year (IGY, 1957-1958): Some Canadian examples

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ABSTRACT:

It is very appropriate for the Eastern Snow Conference (ESC) of 2010 to have a session on "International Polar Year and Beyond". The IPY of 2007-2009, with all its activity and excitement, is now over and it is time to look seriously at the follow-through from this special year. Which aspects should become permanent features of polar research for the years leading up to the next IPY? One way of doing this is to learn from earlier IPYs, especially the International Geophysical Year (IGY) of 1957-58, "the last IPY". Fifty years ago, cold-weather researchers, including members of the ESC, were thinking aloud about their "IGY and Beyond". We can draw on their experience in managing the aftermath of our IPY. This paper contains illustrations of this argument, from a Canadian viewpoint.

At the time of the IGY, Canada was beginning to take full responsibility for its Arctic territory. The national coverage of aerial photography was being completed and detailed mapping of the North was beginning. Following the IGY, the Polar Continental Shelf Project, an IGY research program in the Arctic Ocean, evolved into the Polar Continental Shelf Program (PCSP). This has been Canada's logistical support system for high Arctic research ever since. In the years following the IGY, there was a deliberate increase in emphasis on university research and teaching in the North, greatly aided by the PCSP. Also a great deal of effort was put into establishing benchmarks in Arctic Canada, as a basis for long term measurements, observations and programs to replace the short term "expedition" type research of the day.

In a sense, of course, all activities of a Polar Year form a large psychological benchmark for polar activities. Participants in IPYs generally think of their work in terms of benchmarks. One very concrete datum, for glaciers in the high Arctic, is presented here as an example of a conscious effort to establish long series of high Arctic measurements following the IGY. Soon after, similar series were begun on nearby islands. Maintenance of such data series over decades has not been easy. We should learn from this. Care has to be taken in selecting seeds planted in our IPY that should receive most attention in the years to come.

Keywords: International Polar Year; International Geophysical Year; Arctic Canada

INTRODUCTION

This special session of the Eastern Snow Conference (ESC), on the "International Polar Year and Beyond" is very timely. This is a good time to review and assess what was done in the International Polar Year (IPY) of 2007-2009. What went well and what went less well? Where would it be best to channel resources for the 50 years leading up to the next IPY?

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THE FIRST TWO IPYS

A useful perspective for this exercise can be gained by looking back at earlier IPYs. What worked for them? Which of their seeds fell on barren ground? Which seeds flourished? In this paper we look particularly at the "Third IPY", the International Geophysical Year (IGY) of 1957-58, from a Canadian perspective. The ESC was alive and well at that time. The recent IPY was the Conference's second!

The first IPY was organized in 1882–83. It was a remarkable example of international cooperation in science. Although the emphasis was on the northern hemisphere, great efforts were made to conduct simultaneous measurements and observations in the Subantarctic and the North. Researchers involved were very conscious of the fact that the polar regions provided a good vantage point for studying the whole globe and its atmosphere. They worked to establish baselines for future study of the polar regions and the globe. The IPY itself became a benchmark for global co-operation in research that still influences us today. There was a great emphasis on physical science but other sciences were not entirely neglected (Barr, 2008).

The emphasis on atmospheric sciences might be cited as an example of a benchmark for measurements, observations and programs that bore fruit in following decades. The atmospheric observations of the first IPY ranged from routine weather observations (but made within north and south polar synchronized programs) and studies of air masses and fronts to observations of aurora and magnetism. This work led to understanding of frontal systems, improved weather forecasting and knowledge of the layering of the atmosphere, with all the implications of the last mentioned for communications and space travel. On the other hand one example of research that did not pan out was their observations of the height of the aurora which were of little use because of faulty technique (Barr, 2008, p.368).

Canada was not an official participant in that IPY although several of the projects were on Canadian territory and Canadian officials and scientists assisted in it.

The second IPY, organized in 1932–33, benefited directly from experience of the pioneers of 1882–83. They had the advantage of radio for their programs of synchronized measurements and observations around the globe. Indeed wireless telegraphy and marine and aerial navigation were among the main research focuses (in the first IPY, only one station, in Norway, had access to the telegraph). Canada was a full participant in this IPY.

The International Geophysical Year of 1957–58 began as a "Polar Year" but it was felt that the state of communications and the stage of development of global geophysics merited a name change (Barr, 2008, p.378). It was in effect the third IPY. It was a truly bi-polar effort.

THE THIRD "INTERNATIONAL POLAR YEAR" AND CANADA

During the 1950s, Canada was systematically moving to take full responsibility for its Arctic territory. There was growing concern about sovereignty in the high Arctic. During the IGY of 1957–1958, there was considerable activity at the newly established weather stations of northern Canada which became bases for a wide variety of research programs (e.g. Thomas, 1974). A great deal was done towards improving communications, navigation, mapping and travel in the high Arctic. The air photo coverage of northern Canada was completed in those years, a major baseline for the study of the earth's surface and land-based mapping. This was the time of the first satellites which were to have enormous influence on polar research, in Canada and elsewhere. In the Canadian North, developments such as the DECCA navigation system had almost immediate impacts on travel and surveying (Proc, 2010). The Polar Continental Shelf Programme was a Canadian IGY research program that reflected the increased interest in the high Arctic and concerns about sovereignty in the Arctic Ocean. Current Canadian activity in the Arctic Ocean and between the Arctic Islands can be traced back to those years. The Geological Survey of Canada was active in the islands of high Arctic Canada during and after the IGY, studying the geology revealed by the new air photos. There was already a focus on oil rich areas (Vadden, 1992). This is also an interest that continues to the present day.

At the end of the 1950s, groups of people were getting together to review and assess the IGY, just as the Eastern Snow Conference is doing this year. In Canada, one of their conclusions was that both polar research and polar teaching should be nurtured. With regard to the research, in 1959, the Polar Continental Shelf Programme was changed into the Polar Shelf Research Project (PCSP), (Foster and Marino, 1986). This has been the field research support program for the Canadian high Arctic for decades. It provides aircraft, communications and other support to researchers in the field. The PCSP has been particularly supportive of university research in the North. One of the great concerns in Canada following the IGY was the development of home grown polar researchers. On campuses across Canada, there was a push on polar teaching that eventually resulted in the development of "Northern Studies" programs (Symons, 1975) in more than 30 universities which combined as the Association of Canadian Universities for Northern Studies (Graham and Long, 1997; Lloyd, 1987). This association itself became a stimulator of polar teaching and research in the universities and colleges of Canada.

Although Canadian university students were involved in polar teaching and research before the IGY, it became a benchmark, even a spring board, for those activities in the following decades.

One of the concerns following the IGY was that Canadian students gain experience of polar research in the field and that they be taught in the field. It was no coincidence that in 1959, the year after the IGY, McGill University launched the first of its expeditions to Axel Heiberg Island, Nunavut (Müller, B.S. 1961) The following year, the Arctic Institute of North America.(then located on the McGill campus) launched its Devon Island Expedition (Apollonio, 1960). Both of these ventures evolved into productive high Arctic field stations, bases for teaching and research for undergraduate and graduate students. Both initiated series of measurements that continue to the present day.

If you read early reports from the Devon Island and McGill Expeditions (e.g. Apollonio, 1960; Müller, B.S., 1961; Müller F. *et al*., 1963), it is clear that they knew they were following up on the IGY. It is also clear that they were deliberately setting benchmarks of all sorts for the decades to come. As an example of this, we mention work on Devon Island and deal in some detail with glacier benchmarks from Axel Heiberg.

In the case of Devon Island, still an active centre for research during the recent IPY, Boon *et al*. (2010) document a remarkable series of ice-cap measurements which extends from 1961 to the present day. This series is the result of enormous effort over the years by field workers, notably the late Fritz Koerner. It should be noted that many series of measurements, initiated after the IGY, did not persist.

On nearby Axel Heiberg Island, in 1959 and 1960, McGill initiated mass balance and other measurements on a number of glaciers, notably Baby Glacier, Crusoe Glacier, Iceberg Glacier, Thompson Glacier and White Glacier, all located around Expedition Fiord, western Axel Heiberg Island. For example, beginning in 1959 researchers went to great lengths to locate the terminuses and margins of the glaciers. Working with the still-new air photos, they established baselines by building rock cairns, from which they surveyed the glacier margins and took carefully positioned photographs. They made measurements of the slope of glacier terminuses. At the same time, they initiated mass balance programs on five of the glaciers, setting benchmarks for measurements of ablation and accumulation for the years to come.

With hindsight, we now know that steady improvements in remote sensing and surveying have made it possible to monitor the shapes and terminus positions of all of these glaciers and more (e.g. Cogley and Adams, 2000; Ecclestone *et al*., 2000). The detail in Figure 1 was unimaginable during the IGY. The cairns and baselines, that cost our colleagues of 50 years ago so much effort, are now artifacts of another era in snow and ice science.

Also, it proved impossible to maintain the annual field measurements necessary for mass balance calculations. These glaciers are close to 80° N. Access to them is still not easy or cheap and for decades following the IGY it was difficult. As a result, the ambitious mass balance programs on all the glaciers but White Glacier and Baby Glacier gradually fell away. The 50 years of results shown in Figure 2 are the product of decades of strenuous activity by students and faculty from McGill University and Trent University (Adams, 2007). You still need humans to dig pits for accumulation measurements and to drill holes for the measurement of ice melt from ablation stakes.

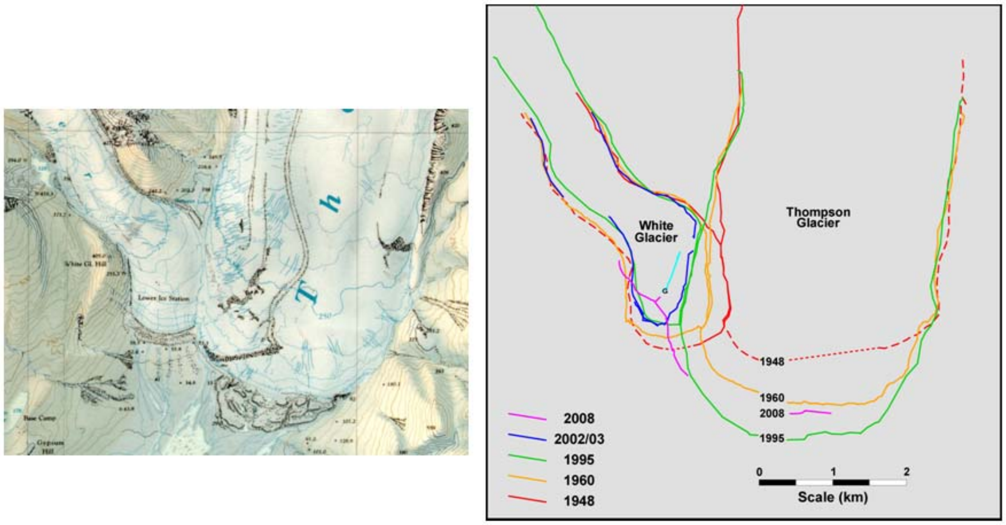

Figure 1. Changes of the terminuses of White and Thompson Glaciers, Axel Heiberg Island, Nunavut, Canada, 1948 to 2008. *a*: Topographic map at 1:50 000 scale based on 1960 air photography (National Research Council, 1962), showing the position and shape of the terminuses in the immediate post-IGY period. This is one example of the value of a benchmark established following the "Third International Polar Year", the International Geophysical Year of 1957–58. *b*: Comparison of the 1960 benchmark to positions at other dates. The 1948 outline was obtained by rectifying an early United States Air Force oblique air photo. Later positions and shapes (and those of some intervening years, not shown here) were obtained in various ways, notably by use of GPS, airborne synthetic-aperture radar (1995) and ground traverses (2002/03, 2008). White Glacier thinned over the measuring period and retreated by some 600 m. During the same period, Thompson Glacier advanced, but at a decreasing rate, reflecting the slower response of a much larger glacier to a warming trend (Cogley and Adams, 2000). The advance of Thompson Glacier appears now to have halted, and it seems to have begun to retreat. This has important implications for the push moraine (Evans and England, 1991; Moisan and Pollard 1995) in front of the glacier.

If the glacier researchers of 1959 and 1960 were here today (and some of them are), they would say that they knew that increasingly sophisticated air photography was going to make monitoring the shape and areal extent of their glaciers much better and easier. However, they would say, even though Sputnik had been launched during the IGY, that they never dreamed that the detail shown in Figure 1 could be achieved, especially with so little physical in-situ effort. They would say that their base lines and markers were necessary as insurance and as a means of enhancing the remote sensing technology (aerial photography) that they could foresee.

On the other hand, those same researchers would say that they over-reached themselves with the mass balance programs that they initiated. Most of the measurement series fell away quite quickly. It proved to be physically and logistically impossible to maintain mass balance programs on all the glaciers. However, those on White Glacier and Baby Glacier have been maintained, more or less unbroken, to the present day. This has largely been accomplished by students, with the enormous assistance of that product of the IGY, the Polar Continental Shelf Program. Even for these two mass balance programs, with hindsight, fewer more carefully chosen measuring sites would have been better (Cogley, 1999).

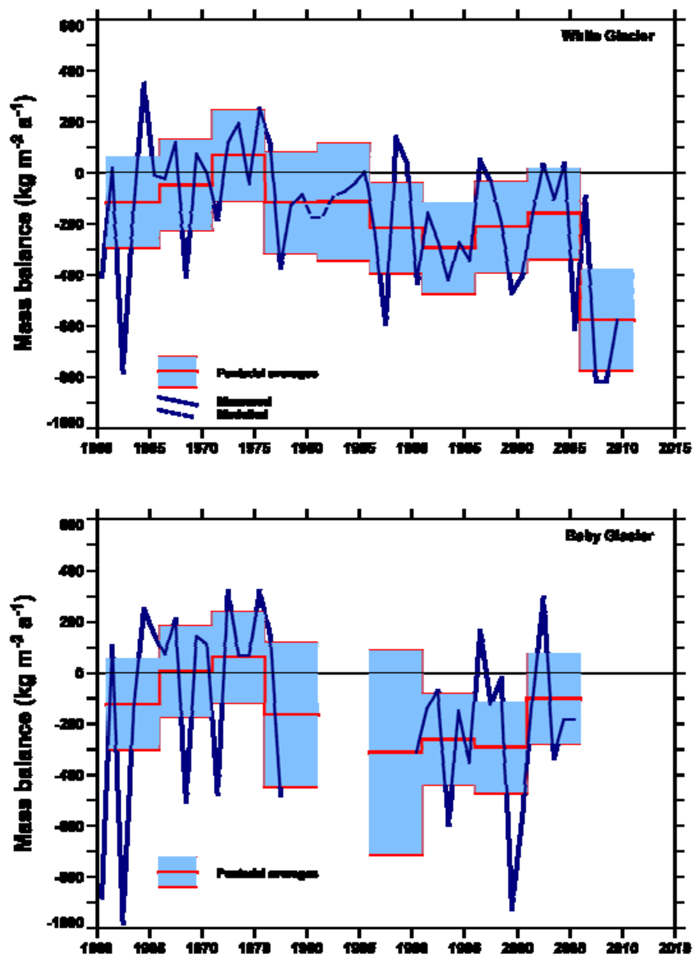

Figure 2. Annual mass balance of White Glacier and Baby Glacier, Axel Heiberg Island, Nunavut, Canada, 1959-60 to 2008-09. Each point represents an annual visit during which pits were dug to measure accumulation and stakes were drilled to measure ablation. Much of this work was accomplished by students of Trent and McGill universities who were part of Northern Studies programs developed after the International Geophysical Year. Records of glacier size like this are rare at high (80° N) latitudes. Mass balance has been consistently negative since the 1970s, with an average rate of loss on White Glacier of –175 mm water equivalent per year since 1959-60. The most recent four years show an average loss of –580 mm water equivalent per year. The horizontal red lines are five-year means.

Figures 1 and 2 are fruits of seeds planted during the IGY. Both have lessons for us as we assess and look forward from the recent IPY. Unanticipated advances in remote sensing and surveying produced a remarkable level of detail for Figure 1. Had the technology stagnated in 1960, we would have had much simpler outlines of the glaciers. Each point in Figure 2 represents an annual visit to each glacier, snow pits dug, and ice melt measured. Despite easier transportation and GPS for locating sites, the number of measurements has decreased over time. It is not easy to maintain support for programs of this type where the ultimate value lies in a long term record. The series faltered badly on a couple of occasions. Practical matters of this type should be given serious consideration in assessing the recent IPY.

Those who initiated these particular measurement series would be proud of their work, while fully recognizing the element of luck in their long term significance. There were no large scale models for global warming when the mass balance records for glaciers on Axel Heiberg and Devon were initiated. The post-IGY researchers did not realize that they were establishing benchmarks for glaciers at latitudes where 21st-century global models would predict the fastest and greatest temperature change. The mass balance records for White and Baby Glaciers, Devon Island Ice Cap, Meighen Ice Cap and Melville South Ice Cap are now especially valuable as a sample of long-term glacier change at high latitudes. We should recognize the importance of the element of luck in trying to plan for the fifty years leading up to the next IPY.

CONCLUDING REMARKS

We have stressed highly visual benchmarks set after the IGY and succeeding series of measurements. However, for polar research in Canada, the IGY itself was a major benchmark in terms of investment in human capital. The determination to invest in the training of homegrown polar researchers brought about a sea change in polar education and research in the country. The effects of this are still being felt.

We should always bear the human dimension in mind when assessing the recent IPY and planning for the future.

ACKNOWLEDGEMENTS

Bill Barr, Steve Gardiner, Marilyn Miller, Polar Continental Shelf Program, Wayne Pollard (Director of the McGill Arctic Research Station) and McGill University.

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