X

EARLY CANADIAN EXPERIMENTS ON ICE (1784-1785)

SOME of the earliest scientific investigations carried out in Canada were the work of British army officers serving in Canadian garrisons in the years following 1763. Written records of these military by-products are rare, and scattered through a variety of publications. One of interest to readers of this *Journal* has recently come to the attention of the writer, not as originally published but as reprinted in the *Annual Register* for 1790. This ancient volume, published in London, was found by Professor John Bland, Director of the School of Architecture of McGill University, Montreal, who, noticing in it the paper on ice research, kindly passed it on to the writer.

In the Natural History section of this old annual review is reprinted a letter first published in Volume Two of the Transactions of the Royal Society of Edinburgh.* In this communication Dr. Charles Hutton quotes from a letter he had received from Major Edward Williams of the Royal Artillery, then stationed at Quebec City. Already established as one of the main military posts in the fledgling country, the citadel of Quebec was beginning to take on the form which to-day makes such a striking scene atop the rocky hill around which Quebec City has developed. It was, therefore, equipped with mortars "for the practice of artillery". The ingenious mind of Major Williams visualized the possibilities presented by the iron bomb-shells used in the mortars for investigating "the force of congelation". He conducted his experiments on some very cold days at the turn of the year 1784.

The bomb-shells, 13 inches long, were hollow, a tapered fuse-hole providing access to the inner cavity. Major Williams filled shells with water and then drove iron plugs into the fuze-holes. When the shells were exposed to the cold, the expansive force of the ice thus formed was sufficient to force out the plugs, even though they were driven in with a sledge hammer, and cylinders of ice "immediately shot up from the holes". Plugs were eventually fixed in position with an ingenious arrangement of springs and the actual rupture of shells was then achieved. In his commentary on the experiments, Dr. Hutton remarks upon the "truly astonishing" force of "congelation" and calculates that "the water, in this instance, expanded in freezing, by a quantity which is between the 17th and 18th part of itself".

It is clear from the simple factual record that Major Williams was a remarkable person. On 22 December, with the temperature $-3°$ F., he watched one of his shells for an hour, hoping to see the plug projected. Since he had his "business" to attend to, he had to leave; in his absence the plug flew out and was lost in the $3\frac{1}{2}$ feet of snow on the ground. As the next step, he "put a mixture of common salt and sal ammoniac to the water (in order to hasten the effect), and tied a long pack-thread, with a piece of red rag at its end, to the fuze, in order to find where it fell in the snow". Even this device failed to locate the plugs but when

* "Experiments on the Expansive Force of Freezing Water . . .", *Annual Register*, Vol. 32, 1790, p. 71-74.

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the snow went in the spring, Major Williams was able to find his plugs and to identify some of them, with the result that he sent this table to Dr. Hutton.

Time	*Therm* [°F.]	*Elev. of the Fuze*	*Weight of Plug* [*ounces*]	*Distance*
1784				
Dec. 21	−10	90	35	Unknown
22	− 3	90	37·25	22 feet
23	−16	90	34·5	Unknown
24	− 6	80	39·25	62
31	−18	45	39·25	387
1785				
Jan. 2	−19	45	41·75	415
4	−12	45	42	Burst
9	− 4	45	40·5	325

The true spirit of inquiry is surely reflected in this simple table, as all who have had to work outside in sub-zero weather (even with modern clothing and conveniences) will appreciate.

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THE POSITION OF MARKERS ON THE GREENLAND ICE SHEET

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The positions of seven markers, erected on the Greenland Ice Sheet were accurately determined by members of the British North Greenland Expedition 1952-54. In three cases the height of a fixed mark above the snow surface was measured. It is hoped that in a decade or two these will be found by future expeditions and their heights redetermined so as to enable a measurement to be made of the rate of movement of the ice sheet and the net accumulation.

The following information about the markers is published for future reference. The probable error in altitude is 10 m. in all cases, and the probable errors are 0·1′ in latitude and 0·5′ in longitude except in the case of A.19 and "Northice".

B.9. Position: lat. 77° 19·4′ N., long. 27° 55·5′ W. Altitude 1713 m. The marker is an open square pyramid with an aluminium sheet as top mark. The lowest of the top screws was 7·9 m. above the snow surface on 1 May 1954.

A.14. Position: lat. 77° 27·7′ N., long. 29° 03·8′ W. Altitude 1812 m. The marker is an iron pipe about 15 cm. diameter.

A.19. Position: lat. 77° 30′ 01″ N., long. 30° 10′ 43″ W. Altitude 1878 m. Probable error 3″ in latitude, 12″ in longitude. Marker similar to B.9. The upper screw at the apex was 7·9 m. above the snow surface on 3 May 1954.

B.32. Position: lat. 77° 41·5′ N., long. 33° 32·5′ W. Altitude 2120 m. The marker is a pole 12 cm. diameter with an orange box as top mark.

"Northice." Position: lat. 78° 04′ 16″ N., long. 38° 29′ 25″ W. Altitude 2345 m. The marker is the lattice anemometer mast. The top cross-bar was 9·1 m. above the snow surface in June, 1953.

B.73. Position: lat. 78° 01·1′ N., long. 45° 47·0′ W. Altitude 2514 m. A pole with canvas top mark.

B.112. Position: lat. 77° 23·8′ N., long. 49° 26·0′ W. Altitude 2530 m. A pole.

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