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J. ROSS MACKAY (1915–2014)

John Ross Mackay, Canada's pre-eminent authority on permafrost, died peacefully in the early morning of 28 October 2014. He was nearly 99 years old. Throughout the geocryological community, Ross was known as an exemplary researcher, an audacious field scientist, and a loyal and friendly man. For more than three decades from the early 1960s, he was acknowledged as Canada's pre-eminent Arctic scientist. His field research in the western Arctic began in 1951 and continued without interruption from 1954 to 2011, although he officially "retired" from the University of British Columbia (UBC) in 1981. He published 201 scientific papers and two memoirs in toto, all but 13 as sole or senior author. His work is the benchmark on thermal contraction cracking in permafrost and on pore-water expulsion during freezing of sands. The permafrost community thus knows him best for his work on ice wedges and pingos, but his expertise on terrain conditions in the western Arctic was perhaps of more immediate material significance. He was told in the 1970s that his work had saved industry two full years of investigations in preparation for hydrocarbon development in the region.

Ross was born in Tamsui, Formosa (now Taiwan), to Canadian missionary parents. His family is renowned in Taiwan, particularly for the extensive medical and educational work initiated by Ross's paternal grandfather, George Leslie Mackay, who founded the Presbyterian Church there. Ross's paternal grandmother, Tiuⁿ Chhang-miâ, was Taiwanese and this, along with his time in Tamsui, gave him a lifelong affinity with the country. When Ross visited Taiwan, he was treated as an icon, with people, particularly nurses-in-training, queuing up to be photographed with him. In Tamsui, where he had developed a fondness for animals and atlases as a child, he was given the key to the city. His paper in *Economic Geography* (1951) declared "geography of the Far East" as one of his research interests.

Ross was sent to school at the Canadian Academy in Kobe, Japan, and went on to Clark (BA, 1939) and Boston (MA, 1941) universities, where he shone. The Second World War interrupted his academic career; nevertheless, he regarded his military service in 1941–46 as his greatest contribution. He enlisted as a gunner (private) in the Royal Canadian Artillery, and transferred to the Canadian Intelligence Corps in 1942. He spent the war breaking Japanese codes, particularly with respect to routing of messages, serving in Ottawa in the same office as Diamond Jenness. A formal history of his unit described him quite simply as "brilliant." In 1945, an American general told him that his work had saved a division (more than 15 000 men). He ended his service with the rank of major, as Commanding Officer No. 1 Discrimination Unit, Directorate of Military Intelligence, Ottawa, having commanded the Intelligence Unit, No. 1 Canadian Special Wireless Group, Darwin, Australia, in 1945. His subsequent career was founded on the reputation he had acquired in the Intelligence Corps. Ross described his activities in cryptanalysis as generically

J. Ross Mackay on the East Channel of the Mackenzie River, July 2010.

equivalent to his academic research. His brother, Leslie, joined the RCAF, and was lost over the English Channel in 1942. He mourned his brother, taken prematurely like so many others, for the rest of his life.

Ross joined McGill University as an assistant professor in 1946 and at the same time started his PhD research, enrolled at the University of Montreal. His "office" was a desk in the department library. During the regular session he taught large classes, dominated by veterans, using only a blackboard and chalk. He then joined the summer school at Stanstead, QC, where he met V. Stefansson and N.E. Odell. His PhD thesis (1949) was on the regional geography of the lower Ottawa valley, but the major paper that he published from it is primarily a robust reinterpretation of the existing theory on the origin of the landscape. As early as 1949, he demonstrated a trademark ability to read the landscape in historical terms and to set straight the published record. He moved to UBC the same year, where he then remained. He was in the office daily from seven to five, and nine to five on Saturdays. There he was a reserved man, but an inspiration and mentor to colleagues with interests quite different from his own, always considering how their work could be incorporated into his research.

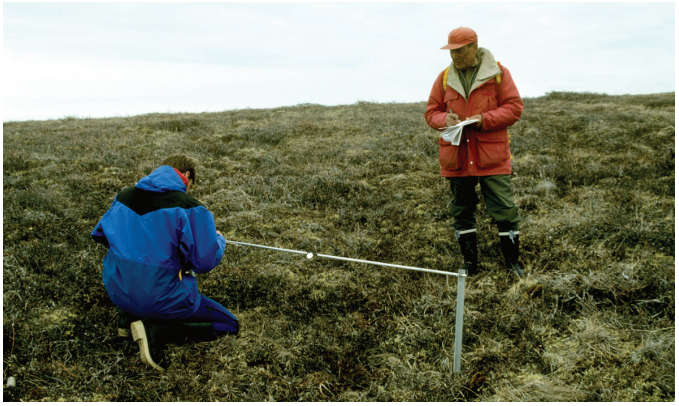
Ross began his Arctic research in the Darnley Bay area of the western Arctic coast, providing interpretive keys that were urgently needed by the newly formed federal Geographical Branch for aerial photographs, given the recent availability of stereoscopic coverage. He was hired for his stellar reputation and as one of the very few Canadians who had advanced training in physical geography at that time. He walked south and east from Paulatuk with his assistants J. Keith Fraser, from the Geographical Branch, and Joe Thrasher, from the community, accompanied by six pack dogs. They had no maps or radios. For navigation, they relied on the aerial photos, a compass, and Joe's knowledge of the terrain. The journey began a life-long friendship with the people of Paulatuk. It also led to Ross's first paper on

Arctic geomorphology, published in 1952. On the journey north from Yellowknife by float plane, the pilot, Ernie Boffa, had been concerned that the water bodies were still frozen about 200 miles short of their destination, so he turned back and dropped down on a small lake, left Ross and Keith there, and said he would return in a week's time. Neither Boffa nor Mackay had a map! In 1960, Ross published observations made during that hiatus. The lake now has a permanent name on the maps of Canada. It is called Stopover Lake.

During the 1950s, after a season on Cornwallis Island in 1952, Ross began to accumulate field experience throughout the western Arctic, traveling by boat along the coast east and west of the Mackenzie delta and walking inland. Most of his journeys were by freighter canoe, driven by a 5 or 10 hp motor, and by schooner. He ran field parties for the Geographical Branch, four times with John Stager, usually with someone from the region as guide and assistant. His published record from the period was dominated by contributions to cartography, although from 1956 on the work in Arctic physical geography became consolidated. His Anderson River memoir, published by the Geographical Branch in 1958, represents field observation at the highest level, but perhaps it was not as influential as his paper in the *Geographical Bulletin* proposing a glacier ice-thrust origin for Herschel Island (1959), which drew on substantial reading of structural geology with W.H. (Bill) Mathews, his friend and collaborator.

Ross was in the vanguard of applying quantitative methods in geographic research. His wartime expertise was in quantitative analysis, and the cartographic papers followed naturally from this. These articles are penetrating and succinct. They set the stage for his application of quantitative methods to permafrost science in the early 1960s, which he turned into a pivotal era in Canadian geocryology. His fundamental paper on pingos published in 1962 and the Mackenzie Delta memoir of 1963, also published by the Geographical Branch, were magisterial quantitative statements on the form and function of the landscape. The paper on pingos is neglected today because few currently study these features and because the *Geographical Bulletin* is not online. In contrast, the memoir remains the authoritative resource on the western Arctic and is regularly cited in research on the region. We should remind ourselves that the numerous diagrams and extensive computations presented were made before the advent of personal computers or even electronic calculators. Slide rules and log tables were tools of the trade, and all of the maps and diagrams were drawn by hand. It is astonishing to find seven publications, including that memoir, on Ross's curriculum vitae for 1963.

Any retrospective view of Ross's career must emphasize his commitment to long-term investigation of geomorphological processes. His field cabin at Garry Island was built in 1964 to enable investigation in winter. He designed field installations sufficiently robust to handle Arctic conditions, simple enough to be read under arduous conditions, and yet critically informative of the processes under investigation. The cabin allowed him to make year-round



J. Ross Mackay recording the deformation of an antisyngenetic ice wedge at Garry Island, June 1992.

field measurements on the dynamics of thermal-contraction cracking and ice-wedge polygon development. Many guests, especially his UBC colleagues who spent a week or so with him at the cabin, were struck by the warmth of his personality and care for their comfort. They became immersed in talk of permafrost and the Arctic, commonly sustained by smoked oysters and lubricated by Glenlivet. The lights of drill rigs on artificial islands twinkled in the Beaufort Sea, not far away.

Ross had no mentor to follow, just Leffingwell's 1919 memoir on the Canning River region in adjacent Alaska, travelers' accounts, such as those by Stefansson, and friends in the Arctic Institute of North America, particularly Link and Tahoe Washburn. Throughout he drew maps: maps of pingos, maps of ice-wedge polygons, maps of active layer depth, usually by plane table. When new technology appeared, he used it imaginatively. In 1969–71, he placed thermistors to measure the temperature below the permafrost table at 10 sites near the Garry cabin and ran several hundred metres of Z-cable into the building to capture the data on chart recorders. The charts were converted by hand into daily values, giving us the first quantitative assessment of the effect of snow accumulation on annual mean ground temperatures at local scale, published in 1974.

Ross's writing is renowned for its clarity and simplicity. It was not always evident that the explanations offered in the papers were the result of exhaustive examination of all potential alternatives, but those who challenged the analyses were subsequently left in no doubt as to why such ideas, after consideration, had been rejected. Some of the clearest examples we have of the experimental method implemented in field science followed from his method of multiple working hypotheses when a conclusion required final testing. The use of snow fences (1978), puncturing of pingos (1977), and drainage of Lake Illisarvik in 1978 are three examples of experiments conducted at landform scale in a manner that is rarely replicated. Ross devoted major effort to statistical summary of his observations, but his explanations were almost always analytical. He rarely used numerical techniques, primarily because of his adherence to Occam's razor. He often stated baldly, "the simplest is the best!"

It is remarkable for a field scientist to present the prime contributions of his career while closing in on retirement. But 1970–81 provided Ross's classical treatment of disturbance to permafrost terrain (1970); segregation as the origin of massive ice (1971); preservation of permafrost and ground ice beneath the Laurentide ice sheet (1972); the origin of offshore permafrost (1972); the development of pingos from pore-water expulsion (1973); the influence of snow cover on ground temperatures (1974); the characteristics of thermal contraction cracking (1974); experimental demonstration of pingo growth (1977); identification of an early-Holocene thaw unconformity (1978); the origin of hummocks (1980); and plug-like flow in solifluction (1981). In the same period a number of his trademark short notes on key points or new techniques appeared: on aggradational ice (1971); a design for a frost tube (1973); regional ground temperatures in the Mackenzie delta area (1974); relict ice wedges (1975 and 1976); permafrost and climate change (1975); problems with probing the base of the active layer (1977); measurement of the widths of ice wedges in oblique section (1977); the effects of wild fire on the active layer (1977); frost heave below 0˚C (1979); and the first report on Illisarvik (1981). These publications demonstrated a distinct loyalty to the Canadian research presses. In the 1950s and 60s, Ross had patronized the *Geographical Bulletin,* but transferred to the *Canadian Journal of Earth Sciences* when the Bulletin ceased publication and to the Geological Survey of Canada's *Reports of Activities* (from 1978 called *Current Research*).

Ross's formal retirement was merely a punctuation mark in his research record. He steered investigations of aggrading permafrost at Illisarvik, the lake he intentionally drained on Richards Island in 1978, turning it into the circumpolar world's longest-running field experiment. From 1982 to 2011 he published 52 papers, concentrating on tundra lakes, ice wedges, and pingos. Investigations of the latter two features culminated in two lengthy contributions to the journal *Géographie physique et Quaternaire* (1998 and 2000). (*GpQ* was the successor name of *Revue canadienne de g*éographie, in which Ross published his first paper in 1947.) Several of the papers drew on decades of field measurements, presenting a temporal perspective on geomorphic processes that will likely remain unmatched. In 2005, he published observations on wind-abraded rocks at Paulatuk, including data he had collected in 1951, and in 2011 his last paper discussed a pingo near Paulatuk that had originally been photographed by Stefansson in 1911. His Arctic field research began and ended at Paulatuk.

The distinction that permeated Ross Mackay's research was recognized through numerous awards and medals. He was the first recipient of the International Permafrost Association's (IPA) Lifetime Achievement Award (2010), of Canada's Centenary Medal for Northern Science (1984), of the Roger J.E. Brown Award of the Canadian Geotechnical Society (1986), and of the Award for Scholarly Distinction of the Canadian Association of Geographers (1972). He was made an Officer of the Order of Canada in 1981 and received the Massey (1967), Miller (1978), Vega (1986), and Logan (1991) medals; five honorary doctorates, including one from the University of Helsinki; and he was elected to eight societies and academies, including the Russian Academy of Natural Sciences. He was the first Canadian to be recognized as an honorary fellow by the International Association of Geomorphologists (1993). The Geological Survey of Canada named its inland waters geophysical research vessel MV *J. Ross Mackay*. Ross was one of only two people who have been elected president of the Canadian Association of Geographers and the Association of American Geographers. From 1983 to 1993 he served as Secretary-General to the International Permafrost Association in its formative years. He was quietly proud of his seven Arctic namesakes, all descendants of Arctic field associates.

Ross had met R.M. Anderson during the war, and at the Andersons' home was introduced to Violet Meekins. They were married for 53 years, but, sadly, she passed away in 1997. Their daughters Anne and Leslie live in British Columbia. Ross and Violet enjoyed the outdoors, especially birding, and they loved the dogs that shared their home. Violet traveled north with Ross many times in summer, staying at Garry Island and Illisarvik, and once in winter at Paulatuk. She insisted that Ross take many of his UBC colleagues to the North so that they might glimpse the reality of his science. Anne was his principal support after her mother's death.

Ross's life was his work. He did not court publicity nor engage in self-promotion. His record is due to single-minded pursuit of excellence, meticulous planning, strategic selection of observations, and unfettered curiosity. The work was received with excitement across a spectrum of disciplines in northern science, from biology and Quaternary studies to physical geography and engineering. His arguments were precise and exhaustive: they could be withering if he was challenged in the press, but were always considered and collegial in private correspondence. It was his brilliance in interpreting the landscape that shook most people: imagine an intellect that could make hills bounce (Pulsating Pingos, 1977)! We will remember him fondly and with the utmost respect.

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