MCGILL OBSERVATORY THROUGH 100 YEARS

by Nancy Bignell

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Weather and time were constant sources of interest to early Montrealers, as they are today, and before 1800 scattered weather records were being kept by a variety of private citizens, sometimes farm-owners and often members of the medical profession. These early records were informal and sometimes lively, with topical notes such as "Governor set off for Quebec in a Calish", or "Six Brigs came in to Port from Europe", among the winds and temperatures. But they were sometimes open to question from a scientific viewpoint. By 1841, John S. McCord, a prominent Montrealer whose son gave his name to the McCord Museum, was deploring the "lack of system in times and manner of observations". He was a member of the Meteorological Society of London, and directed temperature readings by the military guard on St. Helen's Island for the Natural History Society of Montreal.

This active group included many prominent Victorian Montrealers connected with McGill. One was Dr. William Dawson, McGill's Principal; another was Dr. Charles Smallwood, an English-born physician with a great interest in meteorology and astronomy. The latter settled at St. Martin on Isle Jesus, about nine miles west of Montreal, and used his own resources to build an observatory there. In the intervals of his medical career he found time to design and build automatic recording instruments to measure atmospheric electricity, solar and terrestrial radiation, evaporation, rainfall and wind. His small observatory building contained a transit instrument and an accurate clock, an ozonometer, and other more usual weather instruments of the day.

"The whole of this apparatus, even to the electrometers, is the result of his own handicraft", wrote Dr. Hall, another member of the Natural History Society, "and exhibits on his part a mechanical talent of the highest order." He published a number of scientific papers as well as detailed weather summaries, which appeared from time to time in The Gazette.

Dr. Smallwood was appointed Professor of Meteorology at McGill in 1856, one of the first in the British Empire. A few years later the President of the Grand Trunk Railway proposed an observatory in Montreal, suggesting that the University might offer a site, and in 1862 Dr. Smallwood offered to move his instruments "to a small Building capable of receiving the same if such could be erected on the College property, with the ultimate hope that a Government Observatory might hereafter be established" A few months later the work was under way, and the stone tower forming the earliest part of the Observatory was built, at a cost of about $2,000.

Dr. Smallwood was now in late middle age, but he lost no time in taking advantage of his new location. By 1870 the University calendar describes a busy institution which gave "time to the City, and to the Ships in the Harbour", being connected by telegraph with a "Time Ball" at the wharf. "Connection by Electric Telegraph having also been established between the Observatory and the Government Buildings at Ottawa, mean time is furnished daily at noon, and made known there by the firing of a Cannon". The basement of the building was used for observations on terrestrial magnetism, containing a declinometer, a magnetometer and a dip-needle, and the ground storey held the various meteorological instruments. A grant was received annually from the Provincial government, and the Dominion authorities had recognized Dr. Smallwood as one of the handful of official observers in Canada, forming the early beginning of the network of Canadian weather stations as we know it today.

Students were trained as assistant observers, and in the early 1870's a young McGill engineering undergraduate named C.H. McLeod was allowed to room in the main college building (the present Arts Building) in order to take readings at the nearby observatory. He graduated in 1873 with four classmates, fully-fledged Bachelors of Applied Science in Civil and Mechanical Engineering - the first group of McGill engineers to graduate as a class. His diploma was signed by Dr. Smallwood as Professor of Meteorology. Time was running out for the older man, who died after a brief illness just before Christmas, 1873. "As a doctor he was energetic and popular," wrote The Gazette's editor, "but it is as an ardent student of meteorology that his name will live longest." His work "made valuable contributions to the important science to which he was so deeply devoted."

Dr. Dawson asked the newly-graduated engineer to take temporary charge of the Observatory, and young Mr. McLeod went to Toronto to spend a week in the observatory there under the director, Prof. Kingston. At the end of January, 1874, the

first weather report was telegraphed by Mr. McLeod and his assistant under the watchful eye of a telegraph instructor, direct from the Observatory to Toronto. A new era had arrived, in which weather data could be reported at high speed to the head office of Canada's young meteorological service at Toronto. In August, 1874, McGill became a "chief station" in the new Dominion network, making eight observations daily, at three-hourly intervals. Mr. McLeod's temporary job became permanent, and the erstwhile student eventually became Prof. C.H. ("Bunty") McLeod, Ma.E., F.R.S.C., Professor of Civil Engineering, Vice-Dean of the Faculty of Applied Science, and Superintendent of the Observatory for over 40 years.

Providing accurate time was an important Observatory service, and an exact knowledge of longitude was essential for this. Many years earlier, a Captain Ashe of the Royal Navy had calculated longitude for "a station in Viger Garden in this city" by telegraphic signals to Quebec. Prof. McLeod now decided to check this old calculation by direct telegraphic connection with Harvard University Observatory, the base station for the whole continent. Expensive equipment was assembled and arrangements with Harvard made, and in 1883 a series of telegraphic exchanges of clock signals were made, with meticulous observations for determining clock error before and after each signal exchange. Prof. McLeod travelled to Cambridge to make half of the observations, while his Harvard counterpart, Prof. W.A. Rogers, observed at McGill. Harvard generously paid for half of the expense of the work. By 1885 reduction of the results was complete, and the longitude of the pier of McGill's transit instrument established as 4 hours, 54 minutes, and 18.543 seconds west of Greenwich.

McGill was now the base station for Canada, and similar observations were made to determine accurately the longitude difference between McGill and Toronto, and Cobourg, Ontario. But Prof. McLeod was not yet satisfied. Harvard's longitude was the most accurately known in America, based on three separate determinations by the Atlantic cables, but these had been made almost fifteen years earlier. Why should McGill not make an independent determination for Canada by direct connection with Greenwich? Free use of lines and cables was offered by the great telegraph companies, and Canada's Governor General obtained the cooperation of the British Government through the Astronomer Royal. The Dominion made a grant of $2,000 for the work, and experiments were made on signal transmission by specially designed automatic repeaters between land lines and cables.

"Wonderful Telegraphy", exclaimed a headline in The Gazette in 1891 over an account of signals between McGill and Waterville, Ireland to determine time required to cross the Atlantic for interchange of observations with Greenwich. Two Canadian and two English observers did the work, exchanging stations to complete the series of four observations in the summer of 1892. The final result gave a longitude for the Montreal station of 4 hours, 54 minutes and 18.670 seconds west of Greenwich, the only longitude in Canada determined "with that accuracy which meets the requirements of modern geodetic work". This was important at a time when both the U.S. Coast and Geodetic Survey and the Dominion Lands Survey were trying to close the chain of longitudes being carried across the continent, and in 1896 the U.S. agency sent two men to McGill to do longitude work from the Observatory transit pier. The longitude of Harvard itself was revised slightly on the basis of McGill's cable determination, which was verified years later as a remarkably accurate one.

Stars crossing the meridian directly above McGill's transit instrument had to be observed on almost every clear night during the year, in order to correct clock errors. At least six stars had to be timed crossing the nine spider lines of the transit; one polar and one low-south star, and four 'time' stars distributed as symmetrically as possible with reference to the zenith. The error of the sidereal clock would be computed, and then the necessary correction to the mean time clock would be determined. This was the clock used for time distribution, enclosed in a uniform temperature compartment in the basement of the Observatory.

"Few Realize the Responsibility Resting Upon Big Observatory Timepiece", declared the Montreal Witness in 1904. "Even the German Fleet in the Azores Set Their Time By It." The great railway systems of the day received and transmitted McGill time to all stations across Canada; at Canso, Nova Scotia, automatic repeaters carried it to the Azores, where the German Imperial Fleet received time signals from the land. Bermuda and Jamaica received it by manual repeater from Halifax, British naval ships used it at Halifax and Victoria, and the Australian cable carried it to various Pacific islands. "The time signals of the McGill College Observatory are, next to those of the Naval Observatory at Washington, probably the most widely distributed of any existing time service," Prof. McLeod said in 1898. A telegraph line took McGill time to Ottawa for the noon gun and tower clock, but this system encountered difficulties. "The Ottawa time service is a source of annoyance", wrote Prof. McLeod, "owing to the incompetence of the person in charge of

the time gun at the Parliament Buildings." Mr. C. Kirkland McLeod (B.Sc. (Ch.Eng.) 1913), son of Prof. McLeod, recalls that the "person" was an ancient Cockney, who was heard to say that he got the McGill signal, but "it ain't right according to me watch," which he fired the gun by.

For over 60 years the 'time ball' on the Harbour Commissioners Building was dropped daily at noon during the navigation season for the benefit of shipping in the port of Montreal, operated by a switch at the Observatory. This service was important in an era long before the modern radio time signal, when captains depended on the time ball to rate their ships' chronometers; a similar system at Quebec, run by the observatory there, caused "quite a commotion in the Lower Town" when the ball failed to drop one day.

The City of Montreal also received McGill time, and all fire alarm bells were struck at noon daily. The Fire Department circuit ran through the Observatory, where it was connected to a time signal ticker and a bell; Mr. C. Kirkland McLeod recalls that the bell would ring loudly whenever a fire alarm was rung in from a street box, clearly audible to the McLeod family in their home adjoining the Observatory. A number of Montreal's "leading watch and instrument makers" received automatic clock signals over telegraph lines, and McGill class bells were run from the mean time clock. Frequent exchanges of time signals were made with the observatory at Toronto. The office had expanded, and now occupied the basement of the house adjoining the tower and two floors above it, as well as the tower itself.

From the upper floor a special clock sent automatic signals to the Grand Trunk Railway, and records of all the railway's clocks and watches were kept, for which Prof. McLeod was responsible as head of the company's time department in the early 1900's. Costly sidereal clocks were housed in the basement's insulated "clock closet", where the Riefler electric clock was kept under constant pressure inside its glass case. These timepieces were sensitive, and construction of the railway tunnel under the mountain, which started in 1912, caused difficulties which Mr. McLeod Jr. remembers well, as one of his father's undergraduate time assistants.

Meanwhile the Observatory's work was expanding in other directions. Valuable astronomical instruments were given to McGill in 1879, including a telescope and a large transit. The tower was partly rebuilt to accommodate the telescope, with a rotating dome and a heavy stone pier free from connection with

the building. Some of the new instruments were used to observe the transit of the planet Venus across the sun in 1882, for which a "transit model used in the training of the English observers" was brought out to Canada and set up in the "Cupola of the College", to be observed by trainees from a station near the McGill gate. Prof. McLeod travelled to Winnipeg to observe the actual transit, which caused much interest and a certain gentle rivalry between Toronto and McGill Observatories.

As the city grew the McGill site became less suitable for astronomical work, with new buildings and smoke making observations more difficult. In 1882, after the Redpath Museum was built, the transit had to be moved to a small building directly north of the Observatory, in order to get a clear north-south view of the meridian. Sir William Dawson and Prof. McLeod went before the City Council a few years later to ask for a new observatory site on top of the mountain, on "the extreme verge of the park", but this was not forthcoming. Later, Sir William Macdonald, McGill's famous benefactor, bought a site on top of Westmount Mountain, but the city soon reached such a size that even this site was unusable, and was eventually given up to become a park.

These were years of great development at McGill, when the university's reputation was growing, and a series of famous men were coming across the Atlantic to enhance it further. In 1893 Prof. H. L. Callendar of Cambridge University came to McGill to occupy the newly-endowed Macdonald Chair of Physics. A specialist in heat measurement, he worked with Prof. McLeod in a study of soil temperatures, made on the lower campus, as the Observatory site was unsuitable with bedrock only four feet below ground. The reading apparatus was in the new Macdonald Physics Building, and eight Callendar platinum thermometers were buried at depths up to 108 inches "near the northern corner of the tennis grounds".

Prof. Callendar devised a self-recording apparatus for his electrical resistance thermometers, allowing much greater precision in temperature recording. It was decided to use this new invention to study continuous electrical records of temperature differences between two points at different altitudes - the summit of Mount Royal, and the Observatory over five hundred feet below. Two platinum resistance thermometers were placed in screens, one on the summit and the other near the Observatory, and were connected by wire to a recorder. The British Association for the Advancement of Science voted funds to erect the line in 1897, but the insulation was inadequate, and Sir William Mac-

donald again came to the rescue by paying for a lead-covered cable from the mountain summit to the Observatory.

With Dr. H.T. Barnes of McGill, who was later to succeed the famous Lord Rutherford as Macdonald Professor of Physics, Prof. McLeod studied the temperature records, and found that changes at the lower level were anticipated by changes from five to twenty-four hours earlier at the higher station. "In nearly all cases of a sudden change in temperature," he wrote, "we find that the high level instrument is affected several hours ahead," and emphasized the value of such records for local temperature predictions. This work was ahead of its time, detecting the passage of frontal surfaces before they were established as a meteorological concept.

Weather Observations

Regular weather observations continued, and were reported by telegraph to the Central Meteorological Office in Toronto. A wind recorder had been put up on the mountain summit on a tower near the illuminated cross, connected by Sir William Macdonald's cable to an automatic recorder in the Observatory. A sunshine recorder was acquired in 1881, and a few years later an automatic temperature recorder was installed, the ancestor of today's thermograph, with six thermometers and a clock device for tipping them over at given time intervals; the temperature readings would stay in place until the thermometers were reset by the observer.

The equipment thus improved, daily results were published in The Gazette, and monthly reports printed and sent to a variety of subscribers, from insurance agents to legal firms. These reports were much the same as today's; an occasional note, such as "date of first sleighing", shows that they belonged to old, rather than modern, Montreal.

Public demand for weather information was increasing, and Prof. McLeod was often called to Court to testify as an expert witness on weather conditions, as well as civil engineering matters. His time was also filled by administrative work as Vice-Dean of the Faculty of Applied Science, by teaching and also by work as a consulting engineer; after the fire which completely destroyed the Macdonald Engineering Building in 1907, Prof. McLeod with a colleague was in charge of construction of the new building. As Professor of Geodesy and Surveying, he was head of the summer surveying school for years, well

remembered by McGill engineers who were students before the First World War, some of whom were trained at the Observatory in the use of transits, levels and astronomical equipment, and assisted with observations.

"Bunty" McLeod also found time to officiate at student athletics and took a great interest in many undergraduate activities, as well as in the Graduates' Society which he helped to found. He is referred to as "Bunty" to this day by those who remember the short, active professor crossing the campus to his office in the Engineering Building, from his home at the Observatory.

After Prof. McLeod's death in 1917, the Observatory work was continued by two young engineers who had worked under him in the Department of Surveying, James Weir and A. J. Kelly. Prof. Kelly, who directed the Observatory for over twenty years, was another memorable personality. A 1911 McGill graduate, he was in France in 1917 with the famous "Princess Pats", where he won an M.C. and bar at the front. He returned to the university to become in time Chairman of Surveying and Geodesy, and head of the surveying school as Prof. McLeod had been. This was an administrative job of no mean order, as the citizens of Ste. Anne de Bellevue did not always enjoy the surplus high spirits of the engineering students, Prof. Kelly's charges. His friends and acquaintances in Montreal were numerous, and were familiar with his work as Superintendent of the Observatory in the period between the wars, when the time service and weather observations were continued.

The volume of requests from the public and the Courts increased steadily, but importance of astronomical work to check the clocks declined with the advent of noon and 10:00 p.m. radio time signals from Arlington Observatory. Sidereal observations were still made, but not as frequently as before, and the Observatory's small transit house had to be moved to make way for expansion of the Arts Building. Time was transmitted daily to the two great railways, City Hall and the fire stations, as well as to the leading jewellers and several large office buildings, and as late as the 1930's the noon time ball was still being dropped for shipping in the harbour.

Attempt to Move

During the 30's an attempt was made by the Meteorological Service to move the Observatory to Ste. Anne de Bellevue. The

site in the middle of a growing city was not ideal, but the Observatory's services were useful, and the Montreal City Council adopted a resolution against the move. A small weather station was opened at Macdonald College instead, and a few years later the exigencies of World War II created the major meteorological centre at Dorval, with the new transatlantic airport.

After 1945, Profs. G.H.T. Kimble and F. Kenneth Hare, successive Chairmen of the Geography Department, directed the work of the Observatory which was carried out by Mr. Charles Henry, Chief Observer for over twenty years until his retirement in 1958. A year later Prof. Hare was succeeded by Prof. J.S. Marshall, Macdonald Professor of Physics - the third holder of this title to be closely connected with Observatory work, as Profs. Callendar and Barnes were at the turn of the century. Prof. Marshall was Chairman of McGill's active new Department of Meteorology, founded in 1960, and the observatory work is logically associated with this department. The old building has now been torn down, and the meteorological site is on McGill's lower campus, with recorders installed in the Macdonald Physics Building nearby.